# LIST OF EFFECTIVE PAGES

## Chapter 27
## FLIGHT CONTROL SYSTEMS

| CHAPTER | PAGE | DATE | CODE |
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| *27 | i | July 25/69 | AB-18 |
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| 27 | ix | Sep. 25/63 | AB-6 |
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| 27 | 8 | Feb. 15/63 | AB-6 |
| 27 | 9 | Feb. 15/63 | AB-6 |
| 27 | 10 | Aug. 27/62 | AB-4 |
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| 27 | 12 | Aug. 27/62 | AB-4 |
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| 27-0 | 6 | Oct. 15/62 | AB-3 |
| 27-0 | 7 | Oct. 15/62 | AB-3 |
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| 27-1-0 | 6 | Aug. 27/62 | AB-3 |
| 27-1-0 | 7 | Mar. 1/62 | AB-2 |
| 27-1-0 | 8 | Mar. 1/62 | AB-2 |
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| 27-1-0 | 205 | Apr. 17/62 | AB-3 |
| 27-1-0 | 206 | Aug. 27/62 | AB-4 |
| 27-1-0 | 207 | Sep. 25/63 | AB-3 |
| 27-1-0 | 208 | Sep. 25/63 | AB-4 |
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| 27-1-0 | 214 | Apr. 6/64 | AB-7 |

*Pages revised, added or deleted by this revision.

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| 27-1-3 | 204 | Feb. 15/63 | AB-2 |
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| 27-1-4 | 203 | Feb. 15/63 | AB-3 |
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| 27-1-8 | 202 | Mar. 1/62 | AB-1 |
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| 27-1-13 | 204 | Feb. 15/63 | AB-2 |
| 27-1-13 | 205 | June 15/64 | AB-5 |
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| 27-2-0 | 201 | Feb. 15/63 | AB-3 |
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| 27-2-0 | 205 | Aug. 30/61 | AB-1 |
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| 27-2-0 | 207 | Feb. 15/63 | AB-3 |
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| 27-2-1 | 202 | Feb. 20/62 | AB-1 |
| 27-2-1 | 203 | Feb. 20/62 | AB-1 |
| 27-2-1 | 204 | Feb. 15/63 | AB-2 |
| 27-2-2 | 201 | Feb. 15/63 | AB-2 |
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| 27-3-0 | 4 | Mar. 1/62 | AB-2 |

*Pages revised, added or deleted by this revision.

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| 27-3-0 | 203 | Feb. 15/63 | AB-2 |
| 27-3-0 | 204 | Sep. 25/63 | AB-2 |
| 27-3-0 | 205 | Apr. 17/62 | AB-3 |
| 27-3-0 | 206 | Sep. 25/63 | AB-3 |
| 27-3-0 | 207 | Feb. 15/63 | AB-3 |
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| 27-3-0 | 211 | Feb. 15/63 | AB-3 |
| 27-3-0 | 212 | Apr. 17/62 | AB-3 |
| 27-3-0 | 213 | Feb. 15/63 | AB-3 |
| 27-3-0 | 214 | Aug. 27/62 | AB-4 |
| 27-3-0 | 215 | Apr. 17/62 | AB-3 |
| 27-3-0 | 216 | Feb. 15/63 | AB-3 |
| 27-3-0 | 217 | Aug. 27/62 | AB-3 |
| 27-3-0 | 218 | Aug. 27/62 | AB-4 |
| 27-3-0 | 219 | Sep. 25/63 | AB-3 |
| 27-3-0 | 220 | Aug. 27/62 | AB-3 |
| 27-3-0 | 221 | Sep. 25/63 | AB-4 |
| 27-3-0 | 222 | Mar. 1/62 | AB-1 |
| 27-3-0 | 223 | Sep. 25/63 | AB-2 |
| 27-3-0 | 224 | Sep. 25/63 | AB-1 |
| 27-3-1 | 201 | Mar. 1/62 | AB-1 |
| 27-3-1 | 202 | Mar. 1/62 | AB-1 |
| 27-3-1 | 203 | Feb. 15/63 | AB-2 |
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| 27-3-2 | 202 | Nov. 15/64 | AB-2 |
| 27-3-2 | 203 | Mar. 1/62 | AB-1 |
| 27-3-2 | 204 | Feb. 15/63 | AB-2 |
| 27-3-3 | 201 | Mar. 1/62 | AB-1 |
| 27-3-3 | 202 | Mar. 1/62 | AB-1 |
| 27-3-3 | 203 | Feb. 15/63 | AB-2 |
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| 27-3-4 | 202 | Mar. 1/62 | AB-1 |
| 27-3-4 | 203 | Feb. 15/63 | AB-2 |
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| 27-3-4 | 205 | Feb. 15/63 | AB-2 |
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| 27-3-5 | 202 | Mar. 1/62 | AB-1 |
| 27-3-5 | 203 | Feb. 15/63 | AB-2 |
| 27-3-5 | 204 | Mar. 1/62 | AB-1 |
| 27-3-5 | 205 | Feb. 15/63 | AB-2 |
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| 27-3-6 | 202 | Feb. 15/63 | AB-2 |
| 27-3-6 | 203 | Feb. 15/63 | AB-4 |
| 27-3-6 | 204 | Feb. 15/63 | AB-3 |
| 27-3-6 | 205 | Feb. 15/63 | AB-2 |
| 27-3-6 | 206 | Feb. 15/63 | AB-1 |
| 27-3-7 | 201 | Sep. 25/63 | AB-3 |
| 27-3-7 | 202 | Mar. 1/62 | AB-1 |
| 27-3-7 | 203 | Mar. 1/62 | AB-1 |
| 27-3-7 | 204 | Feb. 15/63 | AB-2 |
| 27-3-7 | 205 | Sep. 25/63 | AB-3 |
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| 27-4-0 | 4 | Apr. 17/62 | AB-2 |
| 27-4-0 | 5 | Sep. 25/63 | AB-5 |
| 27-4-0 | 6 | Aug. 27/62 | AB-2 |
| 27-4-0 | 7 | Feb. 15/63 | AB-3 |
| 27-4-0 | 8 | Feb. 20/62 | AB-2 |
| 27-4-0 | 9 | Aug. 27/62 | AB-3 |
| 27-4-0 | 10 | Aug. 30/61 | AB-1 |
| 27-4-0 | 11 | Aug. 27/62 | AB-3 |
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*Pages revised, added or deleted by this revision.

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| 27-4-0 | 205 | Sep. 25/63 | AB-5 |
| 27-4-0 | 206 | Feb. 15/63 | AB-3 |
| 27-4-0 | 207 | Feb. 15/63 | AB-5 |
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| 27-4-0 | 217 | Feb. 15/63 | AB-5 |
| 27-4-0 | 218 | Feb. 15/63 | AB-5 |
| 27-4-0 | 219 | Feb. 15/63 | AB-2 |
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| 27-4-0 | 221 | Feb. 15/63 | AB-1 |
| 27-4-0 | 222 | Feb. 15/63 | AB-1 |
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| 27-4-5 | 202 | Feb. 15/63 | AB-2 |
| 27-4-6 | 201 | Sep. 25/63 | AB-3 |
| 27-4-6 | 202 | Feb. 15/63 | AB-2 |
| 27-4-6 | 203 | Sep. 25/63 | AB-3 |
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| 27-4-8 | 204 | Feb. 15/63 | AB-1 |
| 27-4-9 | 201 | Aug. 27/62 | AB-2 |
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| 27-4-11 | 202 | Sep. 25/63 | AB-3 |
| 27-4-11 | 203 | Sep. 25/63 | AB-2 |
| 27-4-11 | 204 | Sep. 25/63 | AB-4 |
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| 27-4-13 | 204 | Feb. 15/63 | AB-5 |
| 27-4-13 | 205 | Feb. 15/63 | AB-5 |
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| 27-4-13 | 208 | Aug. 27/62 | AB-1 |
| 27-4-14 | 201 | Sep. 25/63 | AB-4 |
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*Pages revised, added or deleted by this revision.

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| 27-5-0 | 6 | Mar. 1/62 | AB-2 |
| 27-5-0 | 7 | Apr. 6/64 | AB-4 |
| 27-5-0 | 8 | Mar. 1/62 | AB-2 |
| 27-5-0 | 9 | Feb. 15/63 | AB-3 |
| 27-5-0 | 10 | Feb. 15/63 | AB-3 |
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| 27-5-0 | 214 | Apr. 17/62 | AB-3 |
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| 27-5-2 | 204 | Feb. 15/63 | AB-2 |
| 27-5-3 | 201 | Sep. 25/63 | AB-3 |
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| 27-5-3 | 203 | Sep. 25/63 | AB-2 |
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| 27-5-4 | 201 | Aug. 27/62 | AB-3 |
| 27-5-4 | 202 | Mar. 1/62 | AB-1 |
| 27-5-4 | 203 | Feb. 15/63 | AB-4 |
| 27-5-4 | 204 | Feb. 15/63 | AB-1 |
| 27-5-5 | 201 | Apr. 6/64 | AB-2 |
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| 27-5-6 | 203 | Sep. 25/63 | AB-4 |
| 27-5-6 | 204 | Sep. 25/63 | AB-2 |
| 27-5-7 | 201 | Apr. 17/62 | AB-2 |
| 27-5-7 | 202 | Aug. 27/62 | AB-2 |
| 27-5-7 | 203 | Mar. 1/62 | AB-1 |
| 27-5-7 | 204 | Apr. 6/64 | AB-5 |
| 27-5-7 | 205 | Aug. 27/62 | AB-2 |
| 27-5-7 | 206 | Feb. 15/63 | AB-3 |
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| 27-5-10 | 202 | Mar. 1/62 | AB-1 |
| 27-5-10 | 203 | Sep. 25/63 | AB-3 |
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| 27-5-12 | 203 | Feb. 15/63 | AB-1 |
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| 27-5-13 | 201 | Sep. 25/63 | AB-4 |
| 27-5-13 | 202 | Mar. 1/62 | AB-1 |
| 27-5-13 | 203 | Feb. 15/63 | AB-2 |
| | BLANK | | |
| 27-5-14 | 201 | Mar. 1/62 | AB-1 |
| 27-5-14 | 202 | Mar. 1/62 | AB-1 |
| 27-5-14 | 203 | Feb. 15/63 | AB-2 |

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| CHAPTER | PAGE | DATE | CODE |
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| 27-5-16 | 202 | Feb. 15/63 | AB-2 |
| 27-5-17 | 201 | Sep. 25/63 | AB-3 |
| 27-5-17 | 202 | Mar. 1/62 | AB-1 |
| 27-5-17 | 203 | Feb. 15/63 | AB-3 |
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| 27-5-19 | 203 | Sep. 25/63 | AB-4 |
| 27-5-19 | 204 | Sep. 25/63 | AB-1 |
| 27-5-20 | 201 | Feb. 15/63 | AB-3 |
| 27-5-20 | 202 | Mar. 1/62 | AB-1 |
| 27-5-20 | 203 | Feb. 15/63 | AB-3 |
| 27-5-20 | 204 | Feb. 15/63 | AB-2 |
| 27-5-21 | 201 | Apr. 17/62 | AB-2 |
| 27-5-21 | 202 | Mar. 1/62 | AB-1 |
| 27-5-21 | 203 | Feb. 15/63 | AB-3 |
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| 27-5-22 | 203 | Feb. 15/63 | AB-2 |
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| 27-5-24 | 203 | Apr. 6/64 | AB-4 |
| 27-5-24 | 204 | Feb. 15/63 | AB-2 |
| 27-5-24 | 205 | Mar. 1/62 | AB-1 |
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| 27-6-0 | 3 | Mar. 1/62 | AB-2 |
| 27-6-0 | 4 | Apr. 17/62 | AB-3 |
| 27-6-0 | 5 | Mar. 1/62 | AB-2 |
| 27-6-0 | 6 | Sep. 25/63 | AB-5 |
| 27-6-0 | 7 | Apr. 6/64 | AB-3 |
| 27-6-0 | 8 | Mar. 1/62 | AB-2 |
| 27-6-0 | 9 | Mar. 1/62 | AB-2 |
| 27-6-0 | 10 | Feb. 15/63 | AB-3 |
| 27-6-0 | 11 | Apr. 6/64 | AB-4 |
| 27-6-0 | 12 | Mar. 1/62 | AB-2 |
| 27-6-0 | 13 | June 15/64 | AB-5 |
| 27-6-0 | 14 | Mar. 1/62 | AB-2 |
| 27-6-0 | 15 | Aug. 27/62 | AB-3 |
| 27-6-0 | 16 | Mar. 1/62 | AB-2 |
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| 27-6-0 | 18 | Mar. 1/62 | AB-1 |
| 27-6-0 | 101 | Feb. 15/63 | AB-3 |
| 27-6-0 | 102 | Feb. 15/63 | AB-2 |
| 27-6-0 | 103 | Sep. 25/63 | AB-2 |
| 27-6-0 | 104 | Aug. 30/61 | AB-1 |
| 27-6-0 | 105 | Aug. 30/61 | AB-1 |
| 27-6-0 | 106 | Mar. 1/62 | AB-2 |
| 27-6-0 | 107 | Mar. 1/62 | AB-2 |
| 27-6-0 | 108 | Aug. 30/61 | AB-1 |
| 27-6-0 | 109 | Mar. 1/62 | AB-2 |
| 27-6-0 | 110 | Aug. 30/61 | AB-1 |
| 27-6-0 | 111 | Mar. 1/62 | AB-1 |
| 27-6-0 | 112 | Mar. 1/62 | AB-1 |
| 27-6-0 | 113 | Mar. 1/62 | AB-1 |
| 27-6-0 | 114 | Mar. 1/62 | AB-1 |
| 27-6-0 | 115 | Mar. 1/62 | AB-1 |
| 27-6-0 | 116 | Mar. 1/62 | AB-1 |
| 27-6-0 | 117 | Mar. 1/62 | AB-1 |
| 27-6-0 | 118 | Mar. 1/62 | AB-1 |
| 27-6-0 | 119 | Mar. 1/62 | AB-1 |
| 27-6-0 | 120 | Mar. 1/62 | AB-1 |
| 27-6-0 | 201 | Nov. 15/64 | AB-5 |
| 27-6-0 | 202 | Mar. 1/62 | AB-2 |
| 27-6-0 | 203 | Apr. 17/62 | AB-2 |
| 27-6-0 | 204 | Sep. 25/63 | AB-4 |
| 27-6-0 | 205 | Jan. 5/65 | AB-4 |
| 27-6-0 | 206 | Sep. 25/63 | AB-5 |
| 27-6-0 | 207 | Apr. 17/62 | AB-3 |
| 27-6-0 | 208 | Apr. 6/64 | AB-4 |
| 27-6-0 | 209 | Aug. 27/62 | AB-3 |
| 27-6-0 | 210 | Feb. 15/63 | AB-5 |
| 27-6-0 | 211 | Aug. 27/62 | AB-3 |

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| 27-6-0 | 214 | Feb. 15/63 | AB-4 |
| *27-6-0 | 215 | Nov. 15/64 | AB-6 |
| 27-6-0 | 216 | Sep. 25/63 | AB-4 |
| 27-6-0 | 217 | Feb. 15/63 | AB-4 |
| 27-6-0 | 218 | Feb. 15/63 | AB-3 |
| 27-6-0 | 219 | Feb. 15/63 | AB-3 |
| 27-6-0 | 220 | Feb. 15/63 | AB-3 |
| 27-6-0 | 221 | Feb. 15/63 | AB-2 |
| 27-6-0 | 222 | Feb. 15/63 | AB-1 |
| 27-6-1 | 201 | Mar. 1/62 | AB-1 |
| 27-6-1 | 202 | Mar. 1/62 | AB-1 |
| 27-6-1 | 203 | Sep. 25/63 | AB-3 |
| 27-6-1 | 204 | Mar. 1/62 | AB-1 |
| 27-6-1 | 205 | Sep. 25/63 | AB-3 |
| 27-6-1 | 206 | Sep. 25/63 | AB-2 |
| 27-6-1 | 207 | Sep. 25/63 | AB-1 |
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| 27-6-2 | 201 | Feb. 15/63 | AB-2 |
| 27-6-2 | 202 | Mar. 1/62 | AB-1 |
| 27-6-3 | 201 | Mar. 1/62 | AB-1 |
| 27-6-3 | 202 | Mar. 1/62 | AB-1 |
| 27-6-3 | 203 | Mar. 1/62 | AB-1 |
| 27-6-3 | 204 | Mar. 1/62 | AB-1 |
| 27-6-3 | 205 | Feb. 15/63 | AB-2 |
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| 27-6-4 | 201 | Feb. 15/63 | AB-2 |
| 27-6-4 | 202 | Mar. 1/62 | AB-1 |
| 27-6-5 | 201 | Sep. 25/63 | AB-3 |
| 27-6-5 | 202 | Sep. 25/63 | AB-3 |
| 27-6-5 | 203 | Sep. 25/63 | AB-3 |
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| 27-6-6 | 202 | Mar. 1/62 | AB-1 |
| 27-6-6 | 203 | Feb. 15/63 | AB-2 |
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| 27-6-7 | 203 | Feb. 15/63 | AB-1 |
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| 27-6-8 | 201 | Feb. 15/63 | AB-3 |
| 27-6-8 | 202 | Mar. 1/62 | AB-1 |
| 27-6-9 | 201 | Feb. 15/63 | AB-2 |
| 27-6-9 | 202 | Mar. 1/62 | AB-1 |
| 27-6-10 | 201 | Feb. 15/63 | AB-2 |
| 27-6-10 | 202 | Mar. 1/62 | AB-1 |
| 27-6-11 | 201 | Feb. 15/63 | AB-2 |
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| 27-6-12 | 201 | Mar. 1/62 | AB-1 |
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| 27-6-13 | 201 | Feb. 15/63 | AB-2 |
| 27-6-13 | 202 | Apr. 17/62 | AB-2 |
| 27-6-13 | 203 | Feb. 15/63 | AB-1 |
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| 27-6-14 | 202 | Apr. 6/64 | AB-3 |
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| 27-7-0 | 3 | Aug. 30/61 | AB-1 |
| 27-7-0 | 4 | Apr. 17/62 | AB-2 |
| 27-7-0 | 5 | Apr. 17/62 | AB-2 |
| 27-7-0 | 6 | Mar. 1/62 | AB-2 |
| 27-7-0 | 7 | Mar. 1/62 | AB-2 |
| 27-7-0 | 8 | Aug. 30/61 | AB-1 |
| 27-7-0 | 9 | Mar. 1/62 | AB-2 |
| 27-7-0 | 10 | Mar. 1/62 | AB-2 |
| 27-7-0 | 11 | Mar. 1/62 | AB-2 |
| 27-7-0 | 12 | Aug. 27/62 | AB-3 |
| 27-7-0 | 13 | Aug. 27/62 | AB-3 |
| 27-7-0 | 14 | Aug. 27/62 | AB-3 |
| 27-7-0 | 101 | Aug. 30/61 | AB-1 |
| 27-7-0 | 102 | Aug. 30/61 | AB-1 |
| 27-7-0 | 103 | Mar. 1/62 | AB-2 |
| 27-7-0 | 104 | Mar. 1/62 | AB-2 |
| 27-7-0 | 105 | Mar. 1/62 | AB-1 |
| 27-7-0 | 106 | Mar. 1/62 | AB-1 |
| 27-7-0 | 201 | Apr. 17/62 | AB-3 |
| 27-7-0 | 202 | Feb. 15/63 | AB-3 |
| 27-7-0 | 203 | Apr. 17/62 | AB-2 |
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| 27-7-0 | 205 | Aug. 30/61 | AB-1 |
| 27-7-0 | 206 | Mar. 1/62 | AB-2 |
| 27-7-0 | 207 | Apr. 17/62 | AB-2 |
| 27-7-0 | 208 | Mar. 1/62 | AB-2 |
| 27-7-0 | 209 | Mar. 1/62 | AB-2 |
| 27-7-0 | 210 | Mar. 1/62 | AB-2 |
| 27-7-0 | 211 | Mar. 1/62 | AB-2 |
| 27-7-0 | 212 | Mar. 1/62 | AB-2 |
| 27-7-0 | 213 | Mar. 1/62 | AB-2 |
| 27-7-0 | 214 | Feb. 15/63 | AB-4 |
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| 27-7-0 | 218 | May 1/65 | AB-4 |
| 27-7-0 | 219 | May 1/65 | AB-5 |
| 27-7-0 | 220 | Nov. 15/64 | AB-4 |
| 27-7-0 | 221 | Nov. 15/64 | AB-4 |
| 27-7-0 | 222 | Feb. 15/63 | AB-3 |
| 27-7-0 | 223 | Aug. 27/62 | AB-1 |
| 27-7-0 | 224 | Aug. 27/62 | AB-1 |
| 27-7-1 | 201 | Jan. 5/65 | AB-3 |
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| 27-7-1 | 203 | Mar. 1/62 | AB-1 |
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| 27-7-1 | 205 | Mar. 1/62 | AB-1 |
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| 27-7-1 | 207 | Mar. 1/62 | AB-1 |
| 27-7-1 | 208 | Jan. 5/65 | AB-4 |
| 27-7-1 | 209 | Jan. 5/65 | AB-3 |
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| 27-7-2 | 201 | Feb. 15/63 | AB-2 |
| 27-7-2 | 202 | Mar. 1/62 | AB-1 |
| 27-7-3 | 201 | Feb. 15/63 | AB-2 |
| 27-7-3 | 202 | Sep. 5/63 | AB-3 |
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| 27-7-4 | 202 | Mar. 1/62 | AB-1 |
| 27-7-4 | 203 | Feb. 15/63 | AB-2 |
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| 27-7-5 | 202 | Mar. 1/62 | AB-1 |
| 27-7-5 | 203 | Feb. 15/63 | AB-2 |
| 27-7-5 | 204 | Feb. 15/63 | AB-2 |
| 27-7-5 | 205 | Feb. 15/63 | AB-1 |
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| 27-7-6 | 201 | Apr. 6/64 | AB-2 |
| 27-7-6 | 202 | Apr. 6/64 | AB-3 |
| 27-7-6 | 203 | Apr. 6/64 | AB-3 |
| 27-7-6 | 204 | Apr. 6/64 | AB-4 |
| 27-7-6 | 205 | Apr. 6/64 | AB |
| 27-7-6 | 206 | Apr. 6/64 | AB |
| 27-7-7 | 201 | Mar. 1/62 | AB-1 |
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| 27-7-7 | 203 | Feb. 15/63 | AB-2 |
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| 27-7-8 | 201 | Sep. 5/63 | AB-3 |
| 27-7-8 | 202 | Mar. 1/62 | AB-1 |
| 27-7-9 | 201 | Feb. 15/63 | AB-2 |
| 27-7-9 | 202 | Mar. 1/62 | AB-1 |
| 27-7-10 | 201 | Sep. 25/63 | AB-3 |
| 27-7-10 | 202 | Mar. 1/62 | AB-1 |
| 27-7-10 | 203 | Sep. 25/63 | AB-3 |
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| 27-7-11 | 203 | Feb. 15/63 | AB-2 |
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| 27-7-13 | 201 | Mar. 1/62 | AB-1 |
| 27-7-13 | 202 | Mar. 1/62 | AB-1 |
| 27-7-13 | 203 | Feb. 15/63 | AB-2 |
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| 27-7-14 | 201 | Aug. 27/62 | AB-2 |
| 27-7-14 | 202 | Aug. 27/62 | AB-2 |
| 27-7-14 | 203 | Aug. 27/62 | AB-2 |
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| 27-7-14 | 207 | Aug. 27/62 | AB-1 |
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| 27-7-14 | 209 | Sep. 25/63 | AB-2 |
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| 27-7-18 | 202 | Mar. 1/62 | AB-1 |
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| 27-8-0 | 1 | Mar. 1/62 | AB-2 |

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| 27-8-0 | 4 | Aug. 30/61 | AB-1 |
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| 27-8-0 | 102 | Aug. 30/61 | AB-1 |
| 27-8-0 | 201 | Sep. 25/63 | AB-4 |
| 27-8-0 | 202 | Sep. 25/63 | AB-4 |
| 27-8-0 | 203 | Aug. 27/62 | AB-3 |
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| 27-9-0 | 3 | Apr. 17/62 | AB-2 |
| 27-9-0 | 4 | Sep. 25/63 | AB-2 |
| 27-9-0 | 5 | Aug. 27/62 | AB-2 |
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| 27-9-0 | 7 | Aug. 30/61 | AB-1 |
| 27-9-0 | 8 | Aug. 30/61 | AB-1 |
| 27-9-0 | 9 | Aug. 30/61 | AB-1 |
| 27-9-0 | 10 | Aug. 30/61 | AB-1 |
| 27-9-0 | 11 | Aug. 30/61 | AB-1 |
| 27-9-0 | 12 | Apr. 17/62 | AB-2 |
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| 27-9-0 | 102 | Mar. 1/62 | AB-2 |
| 27-9-0 | 103 | Aug. 27/62 | AB-2 |
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| 27-9-0 | 108 | Aug. 30/61 | AB-1 |
| 27-9-0 | 201 | Feb. 15/63 | AB-2 |
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| 27-9-0 | 203 | Sep. 25/63 | AB-2 |
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| 27-9-0 | 205 | Aug. 30/61 | AB-1 |
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| 27-9-0 | 209 | Mar. 1/62 | AB-2 |
| 27-9-0 | 210 | Feb. 15/63 | AB-3 |
| 27-9-0 | 211 | Aug. 30/61 | AB-1 |
| 27-9-0 | 212 | Feb. 15/63 | AB-3 |
| 27-9-0 | 213 | Mar. 1/62 | AB-2 |
| 27-9-0 | 214 | Mar. 1/62 | AB-2 |
| 27-9-0 | 215 | Mar. 1/62 | AB-2 |
| 27-9-0 | 216 | Feb. 15/63 | AB-3 |
| 27-9-0 | 217 | Sep. 25/63 | AB-3 |
| 27-9-0 | 218 | Aug. 30/61 | AB-1 |
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| 27-9-2 | 203 | Mar. 1/62 | AB-1 |
| 27-9-2 | 204 | Feb. 15/63 | AB-2 |
| 27-9-2 | 205 | Feb. 15/63 | AB-2 |
| 27-9-2 | 206 | Feb. 15/63 | AB-2 |
| 27-9-3 | 201 | Mar. 1/62 | AB-1 |
| 27-9-3 | 202 | Mar. 1/62 | AB-1 |
| 27-9-3 | 203 | Mar. 1/62 | AB-1 |
| 27-9-3 | 204 | Feb. 15/63 | AB-2 |
| 27-9-3 | 205 | Feb. 15/63 | AB-2 |
| 27-9-3 | 206 | Feb. 15/63 | AB-2 |
| 27-9-4 | 201 | Feb. 15/63 | AB-2 |
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| 27-9-4 | 209 | Feb. 15/63 | AB-3 |
| 27-9-4 | 210 | Feb. 15/63 | AB-2 |
| 27-9-4 | 211 | Feb. 15/63 | AB-2 |
| 27-9-4 | 212 | Feb. 15/63 | AB-2 |
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Chapter 27

# FLIGHT CONTROL SYSTEMS - DESCRIPTION AND OPERATION

## 1. General

The flight control system consists of four primary and nine secondary systems (see Figure 1). The primary systems include the rudder, elevator, aileron and spoiler controls. Pulleys are not incorporated in the primary system; idlers and bell cranks are used for all changes of cable direction. The secondary systems include the primary control surface trim systems, the stabilizer, the elevator auxiliary tabs, the flaps, the extensible leading edge slats and the wing leading edge flaps, the spoiler speed brakes, and the emergency pitch trim function of the spoilers.

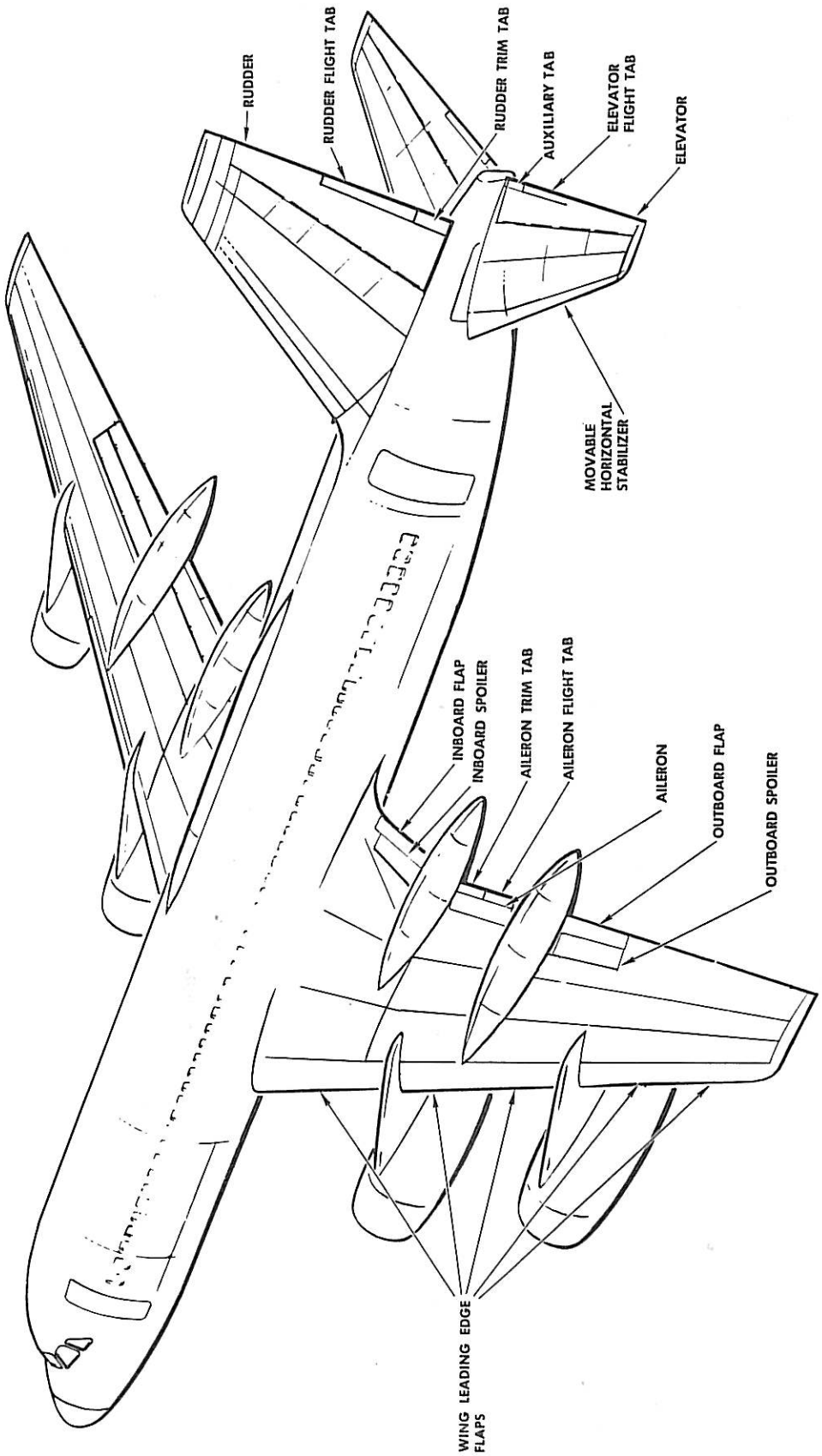
### A. Primary Flight Controls.

Primary systems except the spoilers incorporate a flight tab. The rudder system is power-operated by the airplane's two hydraulic systems and the flight tab is utilized as such only under emergency conditions. Due to the aerodynamic advantage of the flight tab over the main control surface, plus the mechanical advantage of the pilot over the tab, the large forces required to move the main control surfaces are overcome by relatively small pilot input forces. Balance panels are utilized to minimize pilot input to the aileron and elevator control systems. The spoiler system performs functions in the primary and secondary systems. The primary function of the spoilers is to provide the principal means of lateral control. The spoilers are augmented by the aileron system.

### B. Secondary Flight Controls.

The aileron and rudder trim systems use conventional trim tabs actuated by cable and pulley systems controlled by knobs in the flight compartment (see Figure 2). Instead of trim tabs on the elevator, the entire horizontal stabilizer moves as a unit for longitudinal trim. The stabilizer can be either electrically or mechanically controlled and is hydraulically operated during normal operation. The stabilizer trim system also incorporates an emergency mechanical system, operated from the aft lavatory, and an auxiliary electric system operated from the flight compartment.

Spoiler function in the secondary control system is to decrease airplane speed when necessary. A speed brake control handle mounted on the pilots' pedestal controls the flow of hydraulic fluid to actuate the cylinders connected to the under side of the spoiler surfaces for up or


RUDDER
RUDDER FLIGHT TAB
RUDDER TRIM TAB
AUXILIARY TAB
ELEVATOR FLIGHT TAB
ELEVATOR
MOVABLE HORIZONTAL STABILIZER
INBOARD FLAP
INBOARD SPOILER
AILERON TRIM TAB
AILERON FLIGHT TAB
AILERON
OUTBOARD FLAP
OUTBOARD SPOILER
WING LEADING EDGE FLAPS
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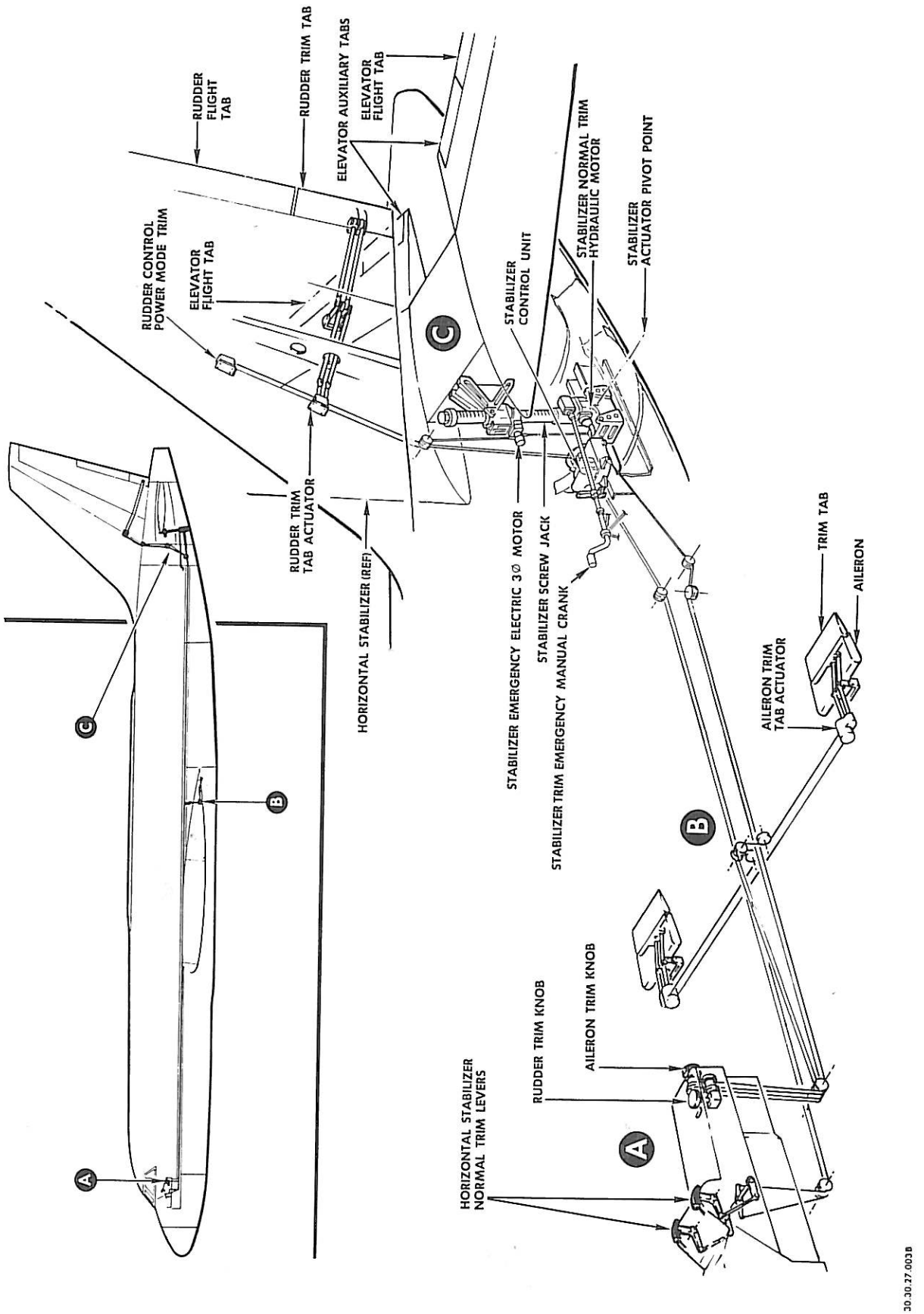





Trim Control Surfaces
Figure 2

down displacement. The inboard and outboard spoilers can be lowered independently for emergency pitch trim by means of electric actuator mechanisms.

Double-slotted, Fowler-type flaps are provided on the wing trailing edge. Each wing incorporates two flaps that are mechanically controlled from the flight compartment. Two hydraulic motors rotate torque tubes and screw jacks to actuate the flaps.

Eight flaps are mounted on the leading edge of each wing. The flaps are hinged at their leading edges and are designed to swing down and forward. Three flaps are located between the fuselage and the inboard pylon, three flaps between the inboard and outboard pylons, and two flaps outboard of the outboard pylon. The flaps on each wing are numbered from one through eight, starting at the fuselage.

Hydraulic pressure, which is supplied by the No. 2 hydraulic system to the leading edge flap actuators, keeps the flaps fully extended or fully retracted. Position of the leading edge flaps is automatically controlled by the flap control lever on the pilots' pedestal.

2. Gust Dampers

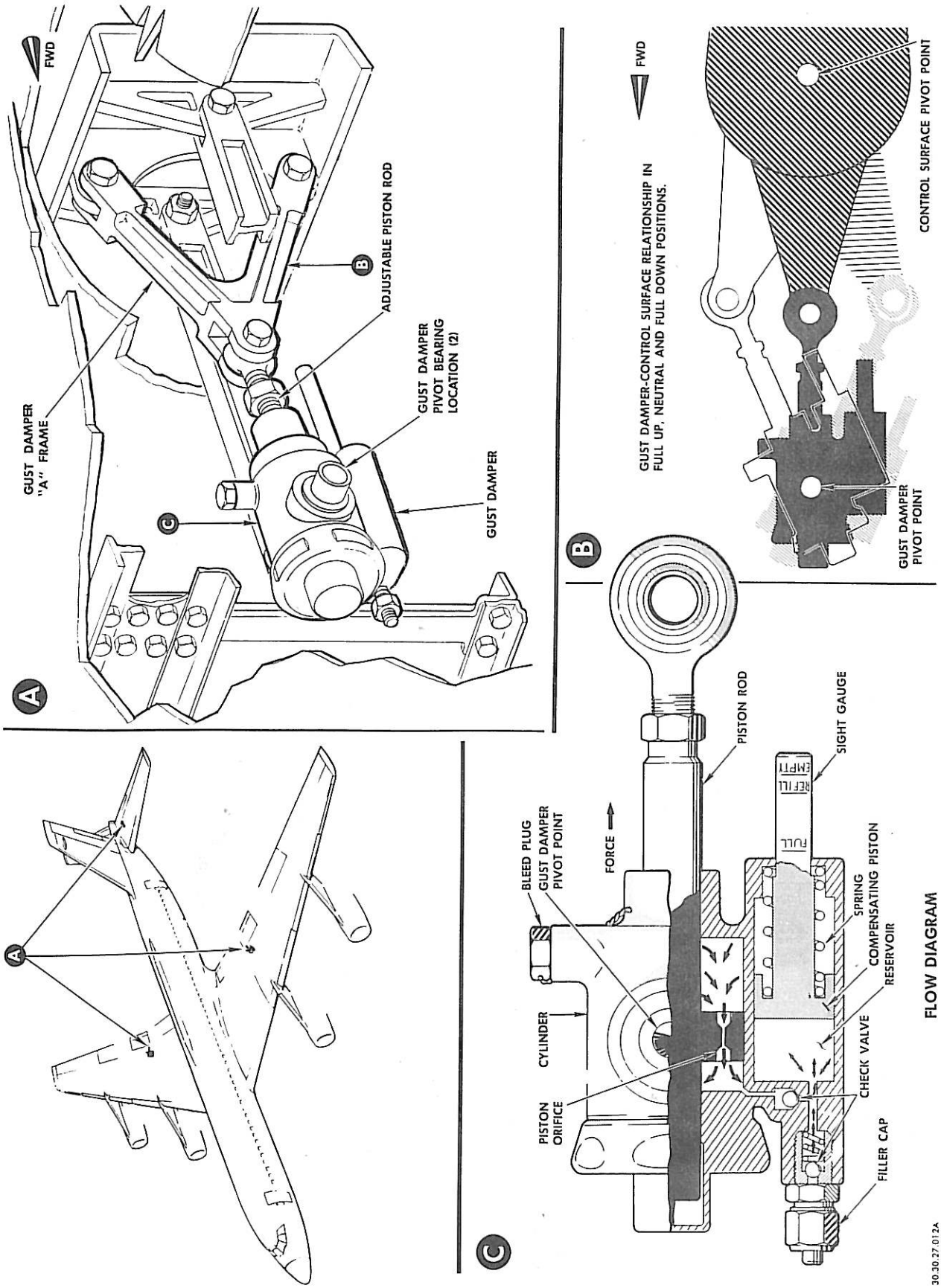
A ground gust protection system is incorporated as part of the flight control system to prevent damage to the control surfaces by wind and to serve as stops for control surface travel. The system is continuously operative, requires no manual control or selection, and does not interfere with normal control surface movement. Each gust damper cylinder is a self-contained unit and has no connection with the airplane's hydraulic system (see Figure 3).

3. Flight Control Systems - Hydraulic

The spoilers and the rudder are actuated by both of the airplane's hydraulic systems. The horizontal stabilizer trim system is powered by the No. 1 hydraulic system and the leading edge flaps are powered by the No. 2 hydraulic system. Schematic diagrams of the flight control hydraulic systems are shown in Figures 4 and 5.

The flaps are positioned by the action of either of two hydraulic motors, each driven by a different one of the two hydraulic systems. These motors are connected through the flap central drive gearbox and a torque tube system to actuators which raise and lower the flaps. Flow of hydraulic fluid to the flap motors is regulated by a flap selector valve mounted on the central drive gearbox and connected mechanically to the control lever on the right side of the pilots' pedestal. A followup mechanism closes the selector valve to stop the operating hydraulic motor when the flaps reach the position corresponding to the setting of the flap control lever.

The airplane is protected against unequal flap extension by six asymmetrical shutoff switches, one located at the outboard end of the flap torque tube drive in each wing and one located in the wing trailing edge structure forward of each individual flap, and by two solenoid-operated flap phase valves, one located in the hydraulic pressure line of each flap motor. If the flaps


A
FWD
GUST DAMPER "A" FRAME
B
ADJUSTABLE PISTON ROD
GUST DAMPER PIVOT BEARING LOCATION (2)
GUST DAMPER
C
B
FWD
GUST DAMPER-CONTROL SURFACE RELATIONSHIP IN FULL UP, NEUTRAL AND FULL DOWN POSITIONS.
CONTROL SURFACE PIVOT POINT
GUST DAMPER PIVOT POINT
A
PISTON ROD
SIGHT GAUGE
REFILL
EMPTY
FULL
BLEED PLUG
GUST DAMPER PIVOT POINT
FORCE
SPRING
COMPENSATING PISTON
RESERVOIR
CYLINDER
CHECK VALVE
PISTON ORIFICE
FILLER CAP
FLOW DIAGRAM
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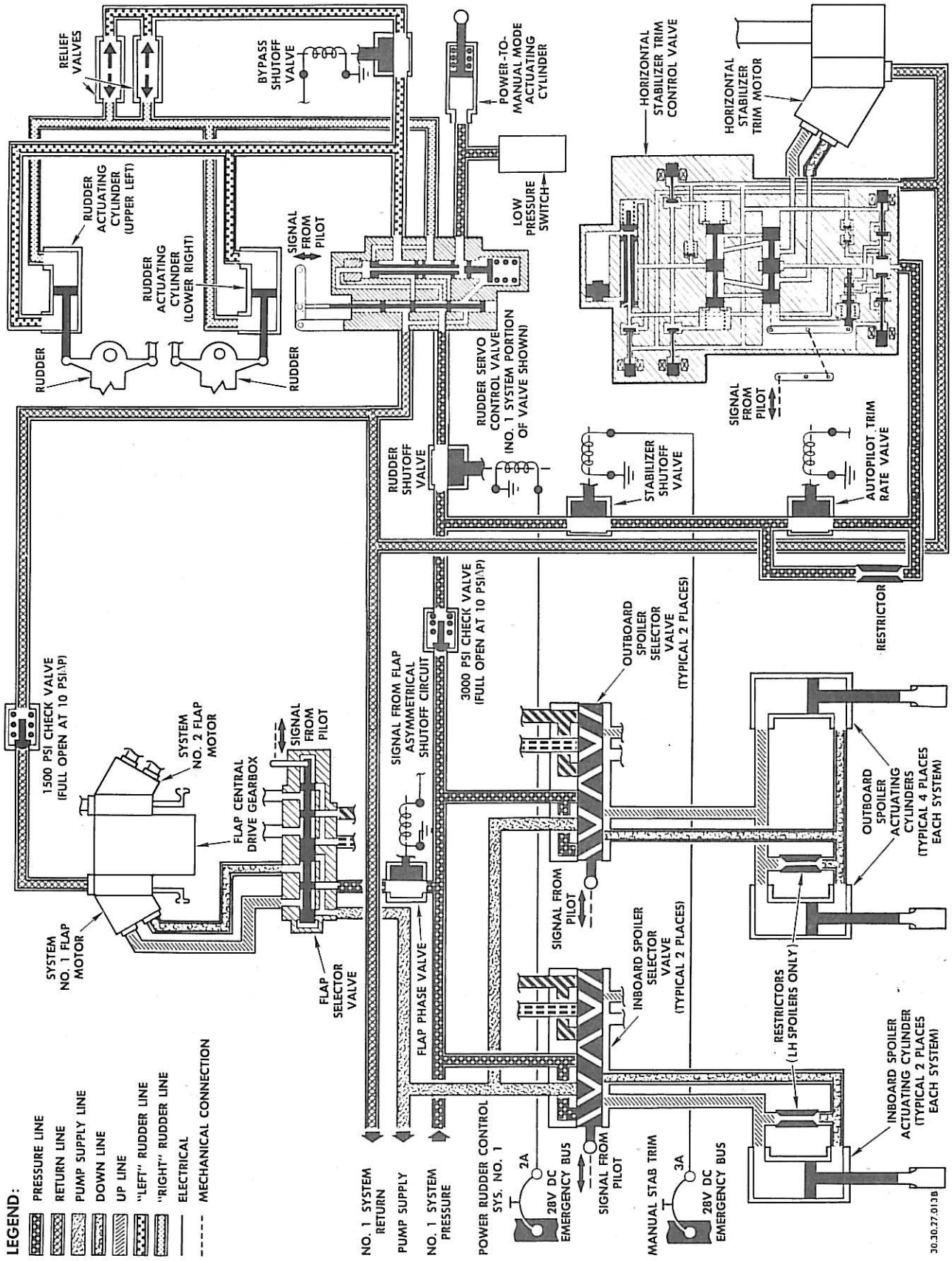
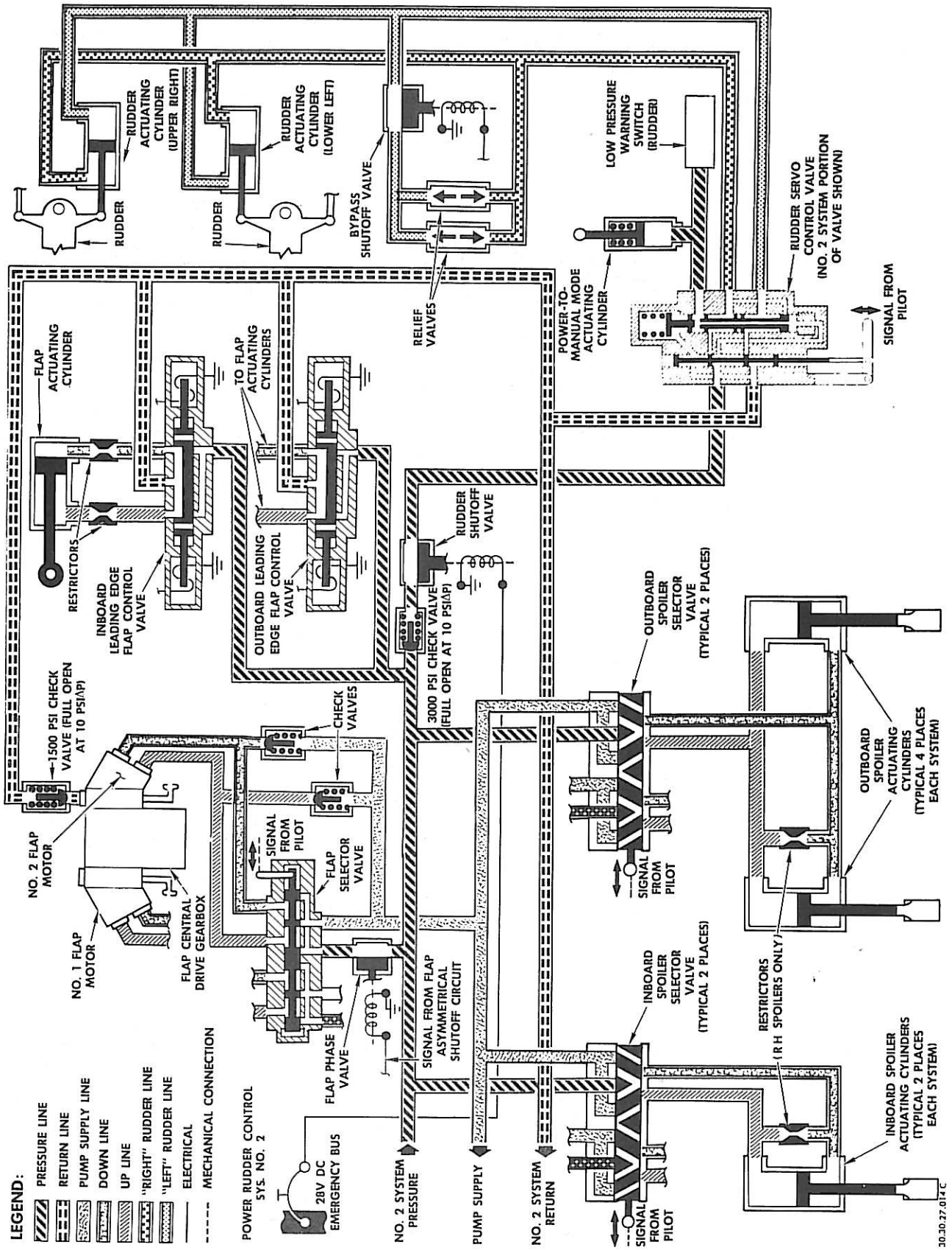



Flight Control Hydraulic System
Using No. 1 Hydraulic System Pressure
Figure 4




Flight Control Hydraulic System
Using No. 2 Hydraulic System Pressure
Figure 5

get out of phase, the asymmetry shutoff switches complete electrical circuits and close the open flap phase valve, shutting off the flow of hydraulic fluid to the operating flap motor.

The leading edge flaps are actuated by 36 hydraulic actuators located in the wing leading edge. Hydraulic fluid from the No. 2 hydraulic system is routed by two solenoid-actuated flap control valves to the leading edge actuators.

The same lever that controls the trailing edge flaps actuates a flap control pulley which actuates control switches to energize extend and retract solenoids in the two leading edge flap control valves. One flap leading edge control valve routes pressure to the inboard flap actuators (flap No. 1), and the other control valve routes pressure to the outboard flap actuators (flaps No. 2 through 8).

Each inboard spoiler has two hydraulic actuating cylinders and each outboard spoiler has four cylinders. The cylinders are in pairs and are located beneath the spoilers. Each main hydraulic system supplies pressure to one cylinder in each set. The outboard spoiler cylinders have a stroke of 2.94 inches and the inboard spoiler cylinders have a stroke of 3.78 inches. The actuating cylinders move the spoilers up or down as required. A servo valve adjacent to each spoiler controls the flow of hydraulic fluid to the actuating cylinders.

Operation of the spoilers for lateral control is initiated by rotating the pilots' control wheels. For speed brake operation, movement of a control lever on the pilots' pedestal, operates a cable and pulley system in the aileron spoiler mixer assembly. The rotational movement of the pulleys is converted to linear motion by push-pull rods and bell cranks. If the air loads reach a critical amount, the spoilers will retract partially, preventing damage to the spoiler surfaces. This spoiler "blow down" is permitted by the designed internal leakage of the spoiler selector valves.

The spoilers are normally operated by both No. 1 and No. 2 hydraulic systems. Should one of the main systems become inoperative, the spoilers may be operated by use of the remaining system. The opening and closing time will be approximately the same as normal; however, spoiler extension will be limited to about half the airspeed which normal system operation allows.

Only the No. 1 hydraulic system is used to operate the horizontal stabilizer trim system. There is no association with the No. 2 hydraulic system. In the normal manual mode of operation, movement of either of the trim levers on the pilots' pedestal opens a valve to port hydraulic pressure to a hydraulic motor. The motor rotates a jack shaft in the horizontal stabilizer screw jack. As the jack shaft rotates it travels through a nut attached to the stabilizer leading edge, causing the stabilizer to move up or down. When the stabilizer reaches the desired setting, releasing the trim lever returns the hydraulic valve to the neutral position and stops the flow of hydraulic fluid to the hydraulic motor.

In the normal electrical mode of operation, trim is accomplished by actuating either stabilizer trim switch located on the outboard horns of the pilots' control wheels. The stabilizer trim switches actuate a hydraulic boost stage in the same hydraulic valve used in the normal manual trim

system, and rotation of the jack shaft through the stationary nut on the stabilizer leading edge is identical. A standby electric trim motor is available to obtain the desired trim setting in the event of a normal system malfunction.

An electrically operated shutoff valve, controlled by a switch in the flight compartment, is incorporated in the hydraulic pressure supply line to the trim motor. Should the trim system become erratic, this valve may be actuated to shut off hydraulic pressure at the trim motor. The hydraulic motor of this system has a seal drain to avoid the collection of hydraulic fluid in its case. This eliminates the possibility of the hydraulic fluid, which might seep by the seal, damaging or causing a malfunction of the motor.

Rudder operation is normally by hydraulic power, but may be by manual mode. The method of operation is determined by the position of the rudder control package in the vertical stabilizer. With normal hydraulic pressure from hydraulic systems No. 1 or No. 2, the control package is locked in the power mode position and movement of the rudder pedals, through cables, bell cranks, and control rod linkage, positions the rudder servo control valve in the control package. The servo control valve directs hydraulic pressure to two pairs of rudder actuating cylinders. One cylinder of each pair receives hydraulic power from a different hydraulic system. With no hydraulic pressure on the rudder system, the control package changes to manual mode and rudder pedal movement actuates the rudder flight tab.

The rudder actuating cylinders serve as mechanical travel stops when the rudder hydraulic power is off. They also function as gust dampers to prevent damage to the rudder when the airplane is on the ground.

Rudder "feel" is simulated by a "Q" cylinder which varies resistance to rudder pedal movement to correspond to variations in airspeed.

4. Flight Control Cables

With the exception of the four short cables in each control column, all of the primary flight control systems use 1/8-inch 1 x 19 nonflexible cable. Nonflexible cable used in the primary flight control systems is composed of an inner core wound in a clockwise lay with 12 wires wrapped around the core in a counterclockwise lay. Tensiometers used on nonflexible cable must be manufactured and calibrated for that purpose.

Flexible cable is used where it is necessary to change cable direction with pulleys. Spoiler/speed brake system cables, flap system cables, and the cables that control the trim tabs are of the 3/32-inch flexible type.

The horizontal stabilizer trim control system employs both flexible and nonflexible cable, each having a diameter of 3/32 inch. The special 3/32-inch 1 x 19 nonflexible cable used in the horizontal stabilizer trim control system, consists of an inner core wrapped in a counterclockwise lay with 12 wires wrapped around the inner core in a clockwise lay. The outer

winding of the cable is in a clockwise lay so that when spliced to 3/32-inch diameter 7 x 7 flexible cable the resulting assembly will not unwind when tension is applied.

The control cables are covered with a protective coating of corrosion preventive compound, MIL-C-16173, Grade 2, which is applied full strength by brushing, dipping or spraying. In areas where cables 1/8-inch in diameter or larger are used, lubricating oil, MIL-L-7870, is applied to the cables where they travel over drums or pulleys; the oil is applied over the protective coating. The protective coating must be removed from the cables for the full length of travel where the cables pass through fairleads or pressure seals.

When it is necessary to clean the cables for inspection or maintenance purposes, dust and dirt accumulations are removed first, then the protective coating is wiped from the cable with a cloth dampened (not saturated) with Stoddard solvent. Cable runs in areas which are not fully protected from the elements, such as in the wings, or in areas exposed to abuse by maintenance personnel will require closer and more frequent inspection to assure that the protective coating has not been accidentally removed or worn off. The protective coating should be reapplied to the cables on an "on condition" basis.

5. Warning Horn System

The power control levers, the landing gears, the stabilizer, the flaps, and the spoilers are all interconnected through the warning horn system. The warning horn will sound intermittently, "one second on - one second off", when the airplane is groundborne and two power control levers are advanced above 92% rpm, if either the flaps or the stabilizer are not set in the proper take-off position, if the SPOILER SELECTOR switch is not in the NORM position, or if the spoiler speed brake handle is out of detent. With the airplane in an airborne condition, the warning horn will also sound intermittently, "one second on - one second off", when two power levers are advanced above 92% rpm if the SPOILER SELECTOR switch is in NORM position and the speed brake handle is out of detent, if the SPOILER SELECTOR switch is in NORM position and one or more spoiler emergency pitch trim actuator is not in normal position. The warning horn will sound continuously with the airplane in airborne condition if any one landing gear is not down and locked when one or more power control levers are retarded below 75% rpm, or when the landing flaps are extended beyond 36 degrees. A block diagram of the warning horn system is shown in Figure 6.

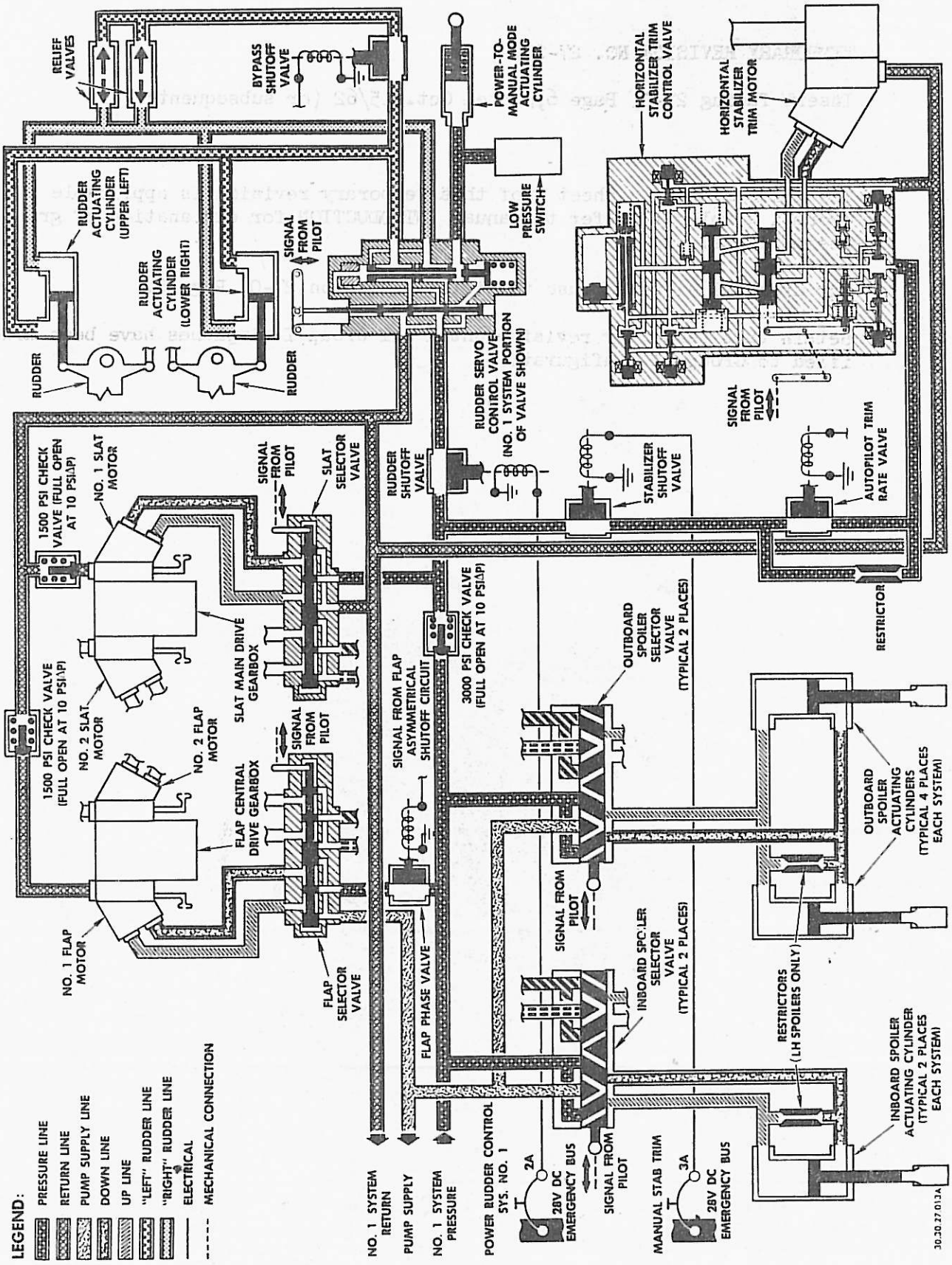
TEMPORARY REVISION NO. 27-23.

Insert facing 27-0, Page 6, dated Oct. 15/62 (or subsequent).

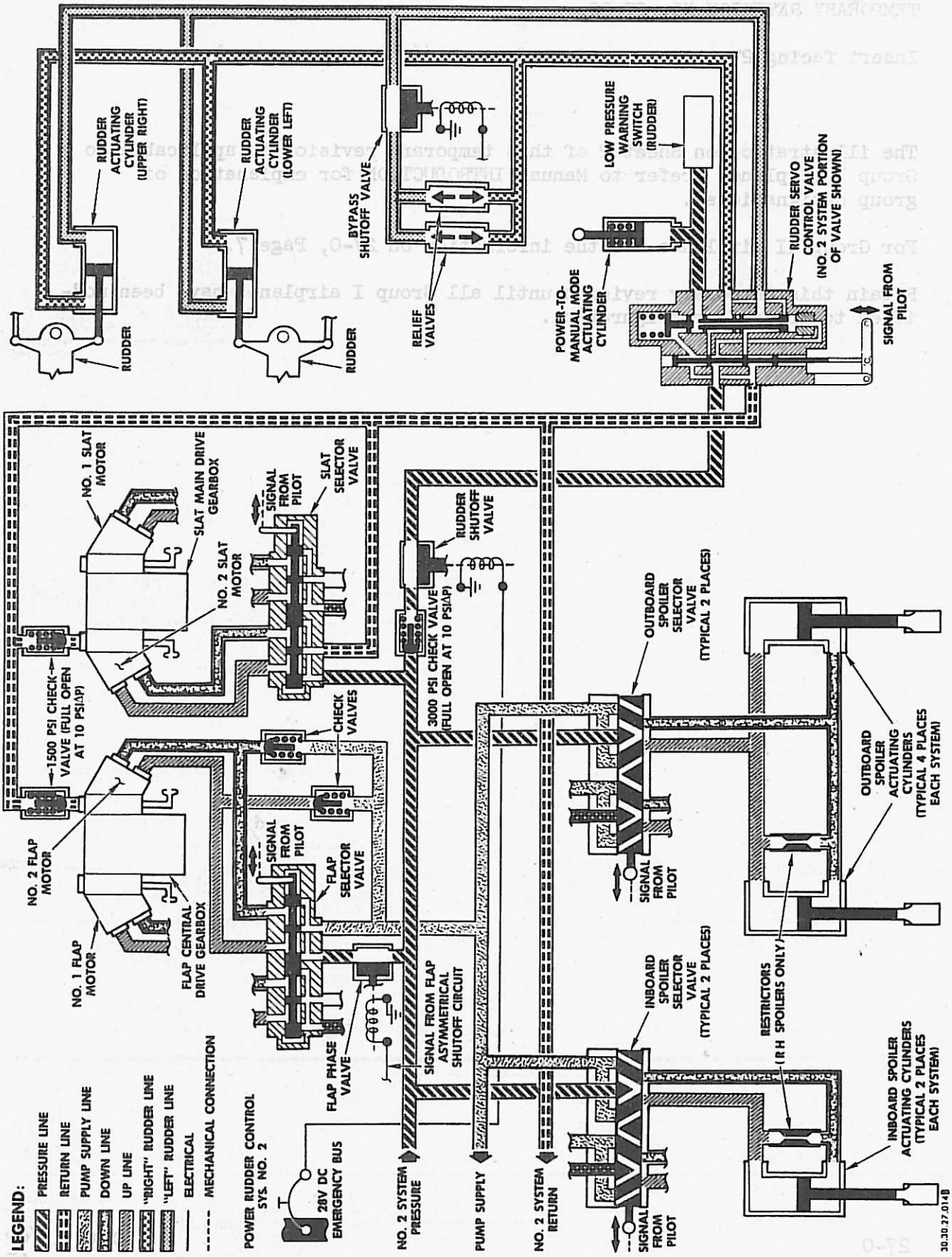
The illustration on Sheet 2 of this temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the illustration on 27-0, Page 6.

Retain this temporary revision until all Group I airplanes have been modified to Group II configuration.




Flight Control Hydraulic System Using
No. 1 Hydraulic System Pressure
Figure 4




Flight Control Hydraulic System Using
No. 2 Hydraulic System Pressure
Figure 5

TEMPORARY REVISION NO. 27-22.

Insert facing 27-0, Page 7, dated Oct. 15/62 (or subsequent).

The illustration on Sheet 2 of this temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the information on 27-0, Page 7.

Retain this temporary revision until all Group I airplanes have been modified to Group II configuration.

TEMPORARY REVISION NO. 27-93

Insert facing 27-0, Page 8, dated Sep. 25/63 (or subsequent).

This temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the information on 27-0, Page 8.

Page 8, delete second paragraph from top of page and substitute the following:

The leading edge flaps and slats are operated by a main drive gearbox driven by two hydraulic motors. Each motor is powered by an independent hydraulic system. Flow of hydraulic fluid to the slat hydraulic motors is regulated by a dual three-way valve connected mechanically to the flap control lever on the pilots' pedestal through a followup linkage and a loop of the same cable system that actuates the flaps.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-92

Insert Section 27-0, Page 8, dated Sep. 25/63 (or subsequent).

This temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

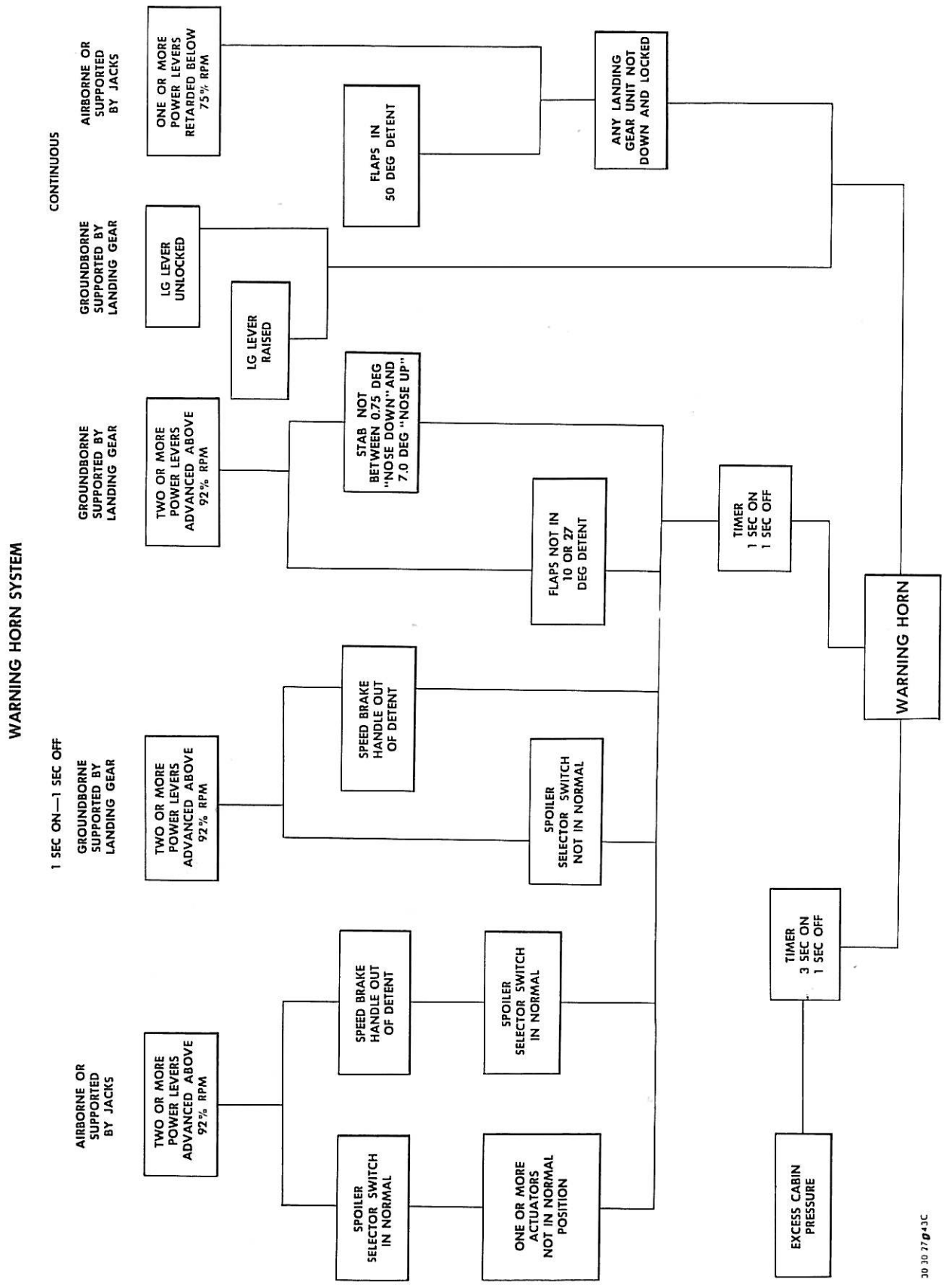
For Group II airplanes use the information on 27-0, Page 8.

Page 8, delete second paragraph from top of page and substitute the following:

The leading edge flaps and slats are operated by a main drive gearbox driven by two hydraulic motors. Each motor is powered by an independent hydraulic system. Flow of hydraulic fluid to the slat hydraulic motors is regulated by a dual three-way valve connected mechanically to the flap control lever on the pilots' pedestal through a followup linkage and a loop of the same cable system that actuates the flaps.

Sep. 25/63 27-0

Page 1 of 1




Warning Horn Block Diagram
Figure 6

FLIGHT CONTROLS - MAINTENANCE PRACTICES

1. Removal/Installation - Control Lever Assembly (see Figure 201)

A. Equipment Required - None.

B. Remove Control Lever Assembly.

(1) Open PEDESTAL & OVHD PANEL LIGHTS circuit breaker on main circuit breaker panel.

(2) Disconnect electrical wires from top cover plate of pedestal.

(3) Remove end cover plates from pedestal.

(4) Detach stabilizer motion indicator cable, take out three mounting screws, and remove stabilizer motion indicator.

(5) Remove thrust reverse levers from power control levers.

(6) Remove knobs from flap, spoiler/speed brake, fuel shutoff, and power control levers.

(7) Locate fuel shutoff levers in full aft position and power control levers in vertical position, remove two cover plate auxiliary sections, take out six mounting screws, and remove pedestal top cover plate.

(8) Loosen turnbuckles in flap and spoiler/speed brake cable loops and remove cable ends from flap and spoiler/speed brake quadrants.

(9) Disconnect push-pull rods from power control and fuel shutoff levers.

(10) Disconnect push-pull rods from stabilizer trim levers, remove nuts from ends of retaining rod, and remove stabilizer trim levers.

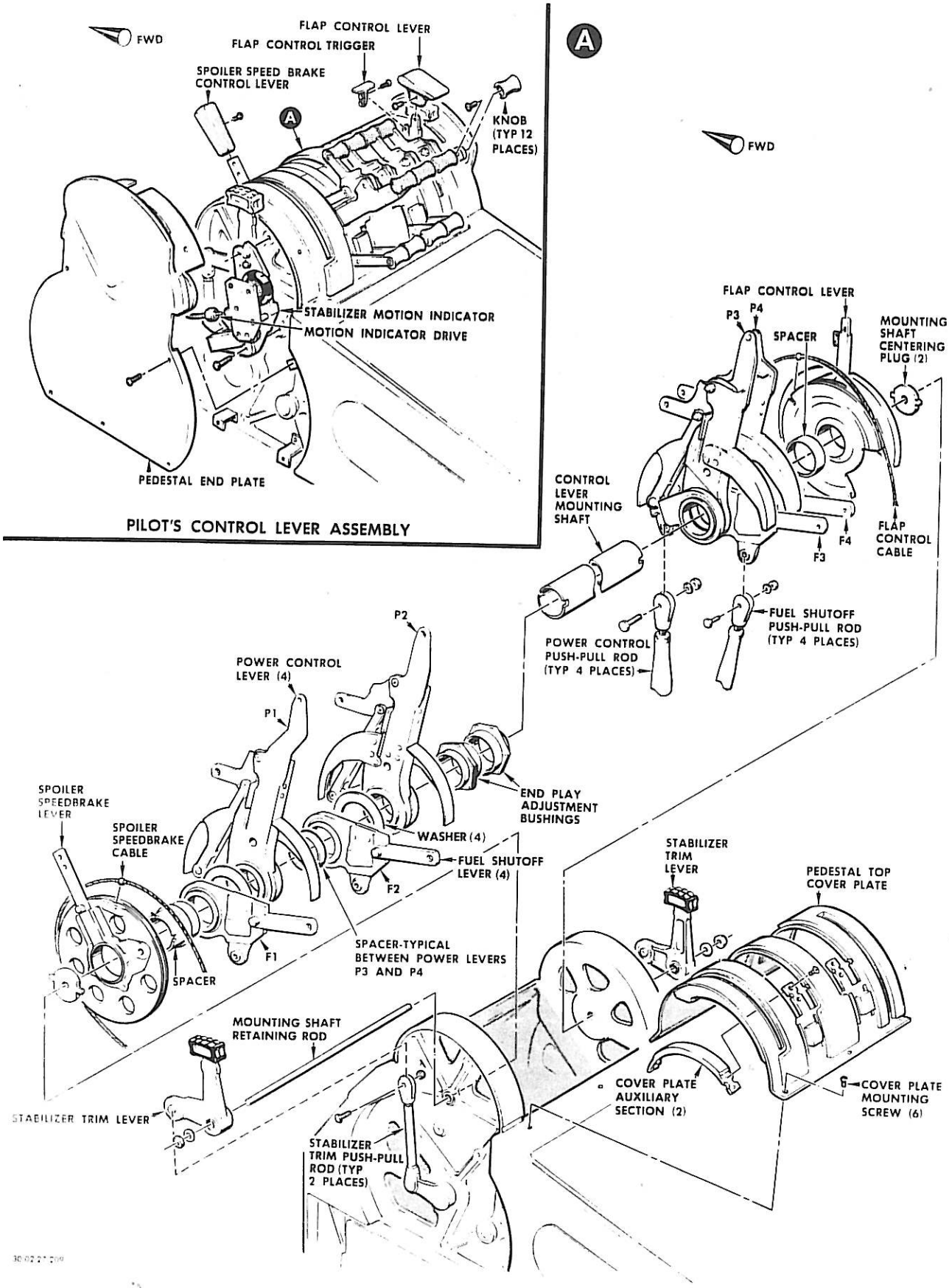
(11) Remove retaining rod from lever mounting shaft and lift control lever assembly out of pedestal.

(12) Remove retaining rod centering plugs from ends of lever mounting shaft.

(13) Slide levers, spacers, quadrants, and end play nut and bushing off of shaft. Tag components for installation.

C. Install Control Lever Assembly.

(1) Screw end play adjustment nut into end play bushing and locate near center of control lever mounting shaft.






Control Lever Assembly Installation
Figure 201

(2) Slide power control bell crank (inbd) on LH end of control lever mounting shaft followed by power control lever P2, fuel shutoff lever F2, narrow spacer, power control bell crank (outbd), fuel shutoff lever F1, wide spacer, spoiler/speed brake lever quadrant and bushing, and retaining rod centering plug.

(3) Slide power control bell crank (inbd) over RH end of control lever mounting shaft followed by power control lever P3, fuel shutoff lever F3, narrow spacer, power control bell crank (outbd), power control lever P4, fuel shutoff lever F4, wide spacer, flap control lever cable quadrant, and retaining rod centering plug.

(4) Position control lever assembly in pedestal and insert retaining rod.

(5) Position stabilizer trim levers on ends of retaining rod and install washers and nuts.

(6) Adjust end play nut in end play bushing to allow free movement of levers without noticeable end play and secure end play nut in bushing with safety wire.

(7) Install push-pull rods on lower ends of trim levers.

(8) Connect control linkages in pedestal and safety as appropriate.

(9) Install cable ends on flap and spoiler/speed brake quadrants.

(10) Locate fuel shutoff levers in full aft position and power control levers in vertical position, slide top cover plate into position over levers, install six mounting screws, and install two cover plate auxiliary sections.

(11) Install knobs on flap, spoiler/speed brake, fuel shutoff, and power control levers.

(12) Connect electrical wires to top cover plate.

(13) Rig and adjust flap control cable and lever assembly (refer to Adjustment/Test Flap Control System Rigging Procedure).

NOTE: If the flap control lever only has been replaced and no other rigging or adjustment in the flap control system has been changed, rig flap system per 27-4-0, steps 1.B.(2) through 1.B.(6).

(14) Rig and adjust spoiler/speed brake control system (refer to 27-3-0, Adjustment/Test - Adjust Spoiler System).

NOTE: If the spoiler/speed brake control lever assembly only has been replaced and no other rigging or adjustment in the spoiler/speed brake control system has been changed, rig spoiler/speed brake system per 27-3-0, steps 1.E.(1) through 1.E.(4). Remove index pin from speed brake aft cable quadrant.

(15) Check operation of flap control system (refer to 27-4-0, Adjustment/Test Flap Control System Functional Test).

NOTE: If the flap control lever only has been replaced and no other rigging or adjustment has been changed in the flap control system, check flap operation per 27-4-0, paragraph 2.G.

(16) Check operation of spoiler/speed brake system (refer to 27-3-0, Adjustment/Test Spoiler/Speed Brake System Functional Test).

NOTE: If the spoiler/speed brake control lever only has been replaced and no other rigging or adjustment has been changed in the spoiler/speed brake control system, check spoiler/speed brake system operation per 27-3-0, paragraph 2.H.

(17) Adjust and check operation of power control, thrust reverse and fuel shutoff linkages (refer to Chapter 76, ENGINE CONTROLS).

(18) Position stabilizer motion indicator, install three mounting screws, and connect motion indicator cable.

(19) Check operation of stabilizer and stabilizer motion indicator per 27-6-0, steps 3.B.(8) through 3.B.(10) and 3.B.(13).

(20) Position pedestal end cover and install mounting screws.

(21) Close PEDESTAL & OVHD PANEL LIGHTS circuit breaker.

(22) Check pedestal light operation (refer to Chapter 33, LIGHTS).

2. Removal/Installation - General Controls Support Assembly (see Figure 202)

A. Equipment Required - None.

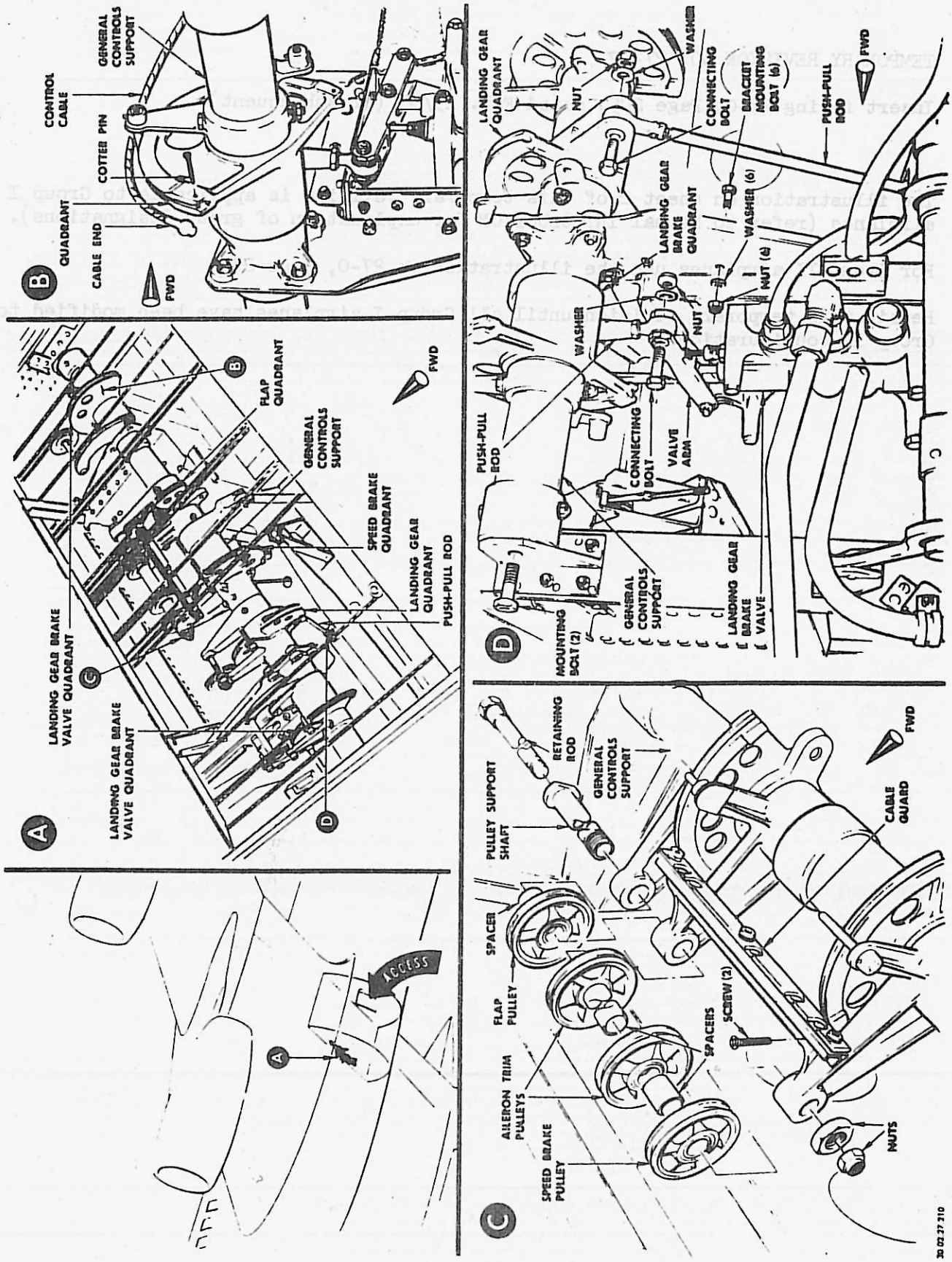
B. Remove General Controls Support Assembly.

(1) Gain access to forward cargo compartment and open zippered access panel at aft end of compartment.

(2) Loosen turnbuckles in aileron trim cables, in flap control cables, in spoiler/speed brake cables, in landing gear cables, and in two sets of landing gear brake cables.

(3) Gain access to hydraulic compartment.

TEMPORARY REVISION NO. 27-27.






General Controls Support Installation
Figure 202

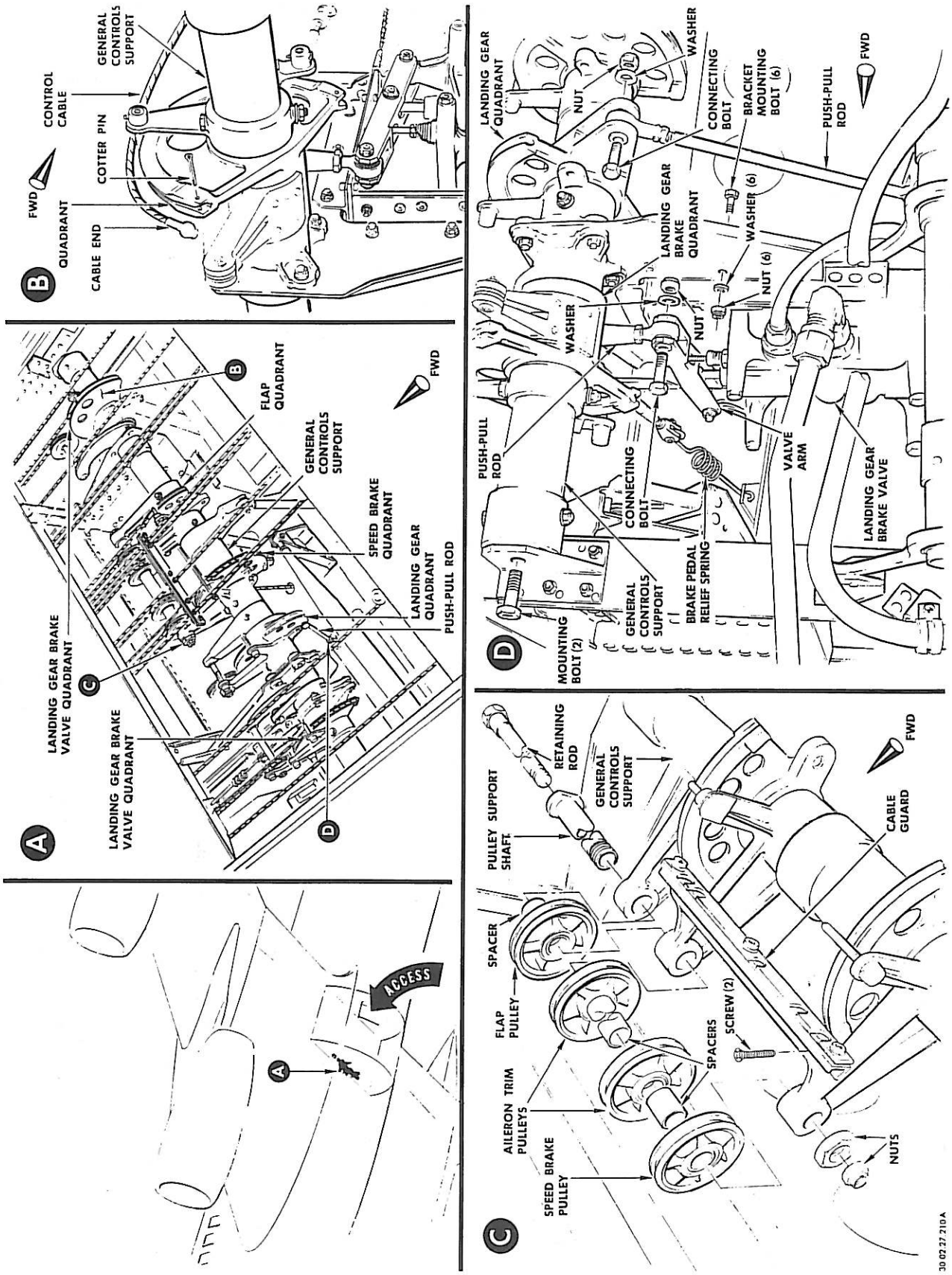
TEMPORARY REVISION NO. 27-27.

Insert facing 27-0, Page 205, dated Feb. 15/63 (or subsequent).

The illustration on sheet 2 of this temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the illustration on 27-0, Page 205.

Retain this temporary revision until all Group I airplanes have been modified to Group II configuration.


A
LANDING GEAR BRAKE VALVE QUADRANT
LANDING GEAR BRAKE VALVE QUADRANT
FLAP QUADRANT
GENERAL CONTROLS SUPPORT
SPEED BRAKE QUADRANT
LANDING GEAR QUADRANT
PUSH-PULL ROD
FWD
ACCESS
B
FWD
CONTROL CABLE
COTTER PIN
QUADRANT
CABLE END
GENERAL CONTROLS SUPPORT
C
PULLEY SHAFT
RETAINING ROD
GENERAL CONTROLS SUPPORT
FWD
CABLE GUARD
SPACER
FLAP PULLEY
AILERON TRIM PULLEYS
SPEED BRAKE PULLEY
SPACERS
SCREW (2)
NUTS
D
LANDING GEAR QUADRANT
NUT
WASHER
CONNECTING BOLT
BRACKET MOUNTING BOLT (6)
PUSH-PULL ROD
FWD
LANDING GEAR BRAKE QUADRANT
WASHER (6)
NUT (6)
WASHER
NUT
PUSH-PULL ROD
CONNECTING BOLT
VALVE ARM
LANDING GEAR BRAKE VALVE
MOUNTING BOLT (2)
GENERAL CONTROLS SUPPORT
BRAKE PEDAL RELIEF SPRING
30 02 27 210A

(4) Remove two screws and detach cable guard on top of general controls support assembly.

(5) Remove nuts from aileron trim pulley support shaft and retaining rod immediately forward of general controls support shaft and remove pulley support shaft and retaining rod. Tag pulleys and spacers for installation.

(6) Detach cable ends from five cable quadrants on general controls support shaft. Tag cables for installation.

(7) Disconnect brake pedal relief springs at each brake metering valve quadrant.

WARNING: STEP (7) MUST BE ACCOMPLISHED PRIOR TO DISCONNECTING LINKAGE FROM BRAKE METERING VALVE QUADRANTS.

(8) Disconnect push-pull rods from five cable quadrant fittings on general controls support shaft.

(9) Remove bolt from each end of general controls support shaft.

(10) Remove 12 mounting bolts and detach support brackets from structure.

(11) Remove controls support assembly.

C. Install General Controls Support Assembly.

(1) Position general controls support assembly and install bolt in each end of general controls support shaft.

(2) Install 12 mounting bolts attaching support brackets to structure.

(3) Connect push-pull rods to spoiler/speed brake, flap control, landing gear, and main landing gear brake quadrant fittings on general controls support shaft.

(4) Install aileron trim pulley support shaft with aileron trim, spoiler/speed brake, and flap pulleys and spacers located as tagged during removal. Loop aileron trim cables over pulleys during installation.

(5) Install cable ends on five cable quadrants as tagged during removal.

(6) Install two screws attaching cable guard on top of general controls support assembly.

(7) Rig and check operation of landing gear system components and main landing gear brake cables (refer to Chapter 32, LANDING GEAR).

TEMPORARY REVISION NO. 27-28

Insert facing 27-0, Page 206, dated Feb. 15/63 (or subsequent).

This temporary revision is applicable to Group I airplanes (refer to Manual INTRODUCTION for explanation of group designations).

For Group II airplanes use the information on 27-0, Page 204.

Page 204, delete step (7) and the warning following step (7).

(8) Rig and adjust aileron trim control system (refer to 27-2-0, Adjustment/Test - Adjust Aileron Trim System).

NOTE: If the aileron trim pulleys only have been replaced and no other rigging or adjustment has been changed in the aileron control system, rig system per 27-2-0, steps 1.B.(2) through 1.B.(6). Aileron trim tab indicator dial on pilots' pedestal must read zero with ailerons and trim tabs in streamline position after accomplishing steps 1.B.(2) through 1.B.(6).

(9) Check operation of aileron trim system (refer to 27-2-0, Adjustment/Test Aileron Trim System Functional Test).

(10) Rig and adjust spoiler/speed brake system (refer to 27-3-0, Adjustment/Test - Adjust Spoiler System).

NOTE: If the spoiler/speed brake control cable pulleys and spoiler speed brake quadrant only have been replaced and no other rigging or adjustment has been changed in the spoiler/speed brake system, rig system per 27-3-0, steps 1.E.(1) through 1.E.(4).

(11) Rig and adjust flap control system (refer to 27-4-0, Adjustment/Test Flap Control System Rigging Procedure).

NOTE: If the flap control cable pulleys and the flap control quadrant only have been replaced and no other rigging or adjustment has been changed in the flap control system, rig system per 27-4-0, steps 1.B.(2) through 1.B.(5).

(12) Check operation of spoiler/speed brake control system (refer to 27-3-0, Adjustment/Test Spoiler/Speed Brake System Functional Test).

NOTE: If the spoiler/speed brake control cable pulleys and spoiler/speed brake quadrant only have been replaced and no other rigging or adjustment has been changed in the spoiler/speed brake control system, check system operation per 27-3-0, steps 2.B.(9) and 2.B.(10).

(13) Check operation of flap control system (refer to 27-4-0, Adjustment/Test Flap Control System Functional Test).

NOTE: If the flap control cable pulleys and the flap control quadrant only have been replaced and no other rigging or adjustment has been changed in the flap control system, check flap operation per 27-4-0, paragraph 2.G.

3. Control System Turnbuckles

NAS turnbuckles which are used in the various cable systems are identical to AN assemblies except that two (2) small grooves are milled lengthwise across the threaded areas of the barrel and one (1) groove is milled across the threads of each cable terminal and are safetied with NAS651 clips and require no safety wire (see Figure 203 for an illustration of a typical turnbuckle and the safety clips).

NOTE: Safety wire can be used with the NAS assembly if locking clips are not available.

4. Installation - Split Cone Bushings (see Figure 204)

A. General.

Split cone bushings are used with tapered bushings to support hinge bolts and keep them from turning.

B. Equipment Required.

(1) Torque wrench with suitable adapters.

(2) Shop fabricated support blocks to support hinge lugs.

(3) Graphite grease, Specification MIL-G-7187.

C. Install Split Cone Bushings.

(1) Align hole in hinge bearing with holes in hinge lup tapered bushings.

(2) Install hinge bolt through tapered bushings and hinge bearing with washer under bolt head and nut. Tighten nut finger tight.

(3) Position support block between each hinge lug and hinge fitting.

(4) Tighten nut on hinge bolt and draw tapered bushings against hinge bearing.

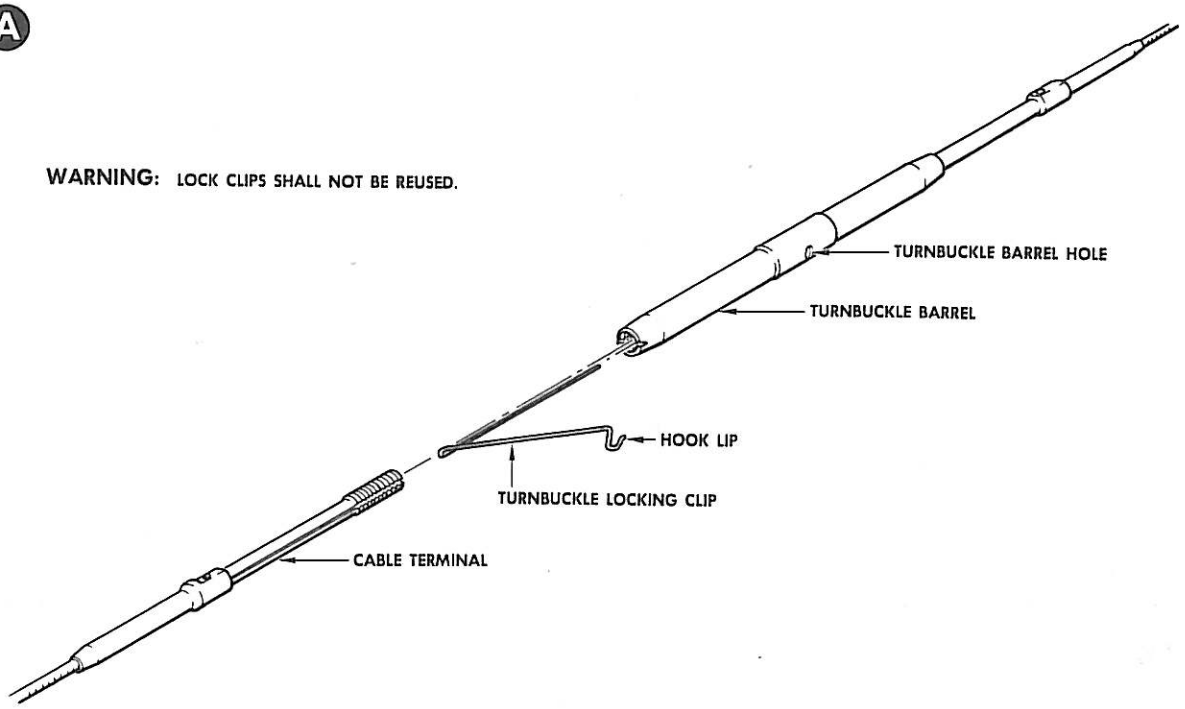
(5) Remove hinge bolt and support blocks and check that gap between each tapered bushing and hinge bearing does not exceed 0.005 inch. If either gap exceeds 0.005 inch, repeat steps (2) through (4).

(6) Apply light coat of graphite grease, Specification MIL-G-7187, to outside surface of two cone bushings and insert cone bushings in tapered bushings. Do not allow graphite grease to come in contact with inner surface of cone bushings.

(7) Install hinge bolt and torque to appropriate value.

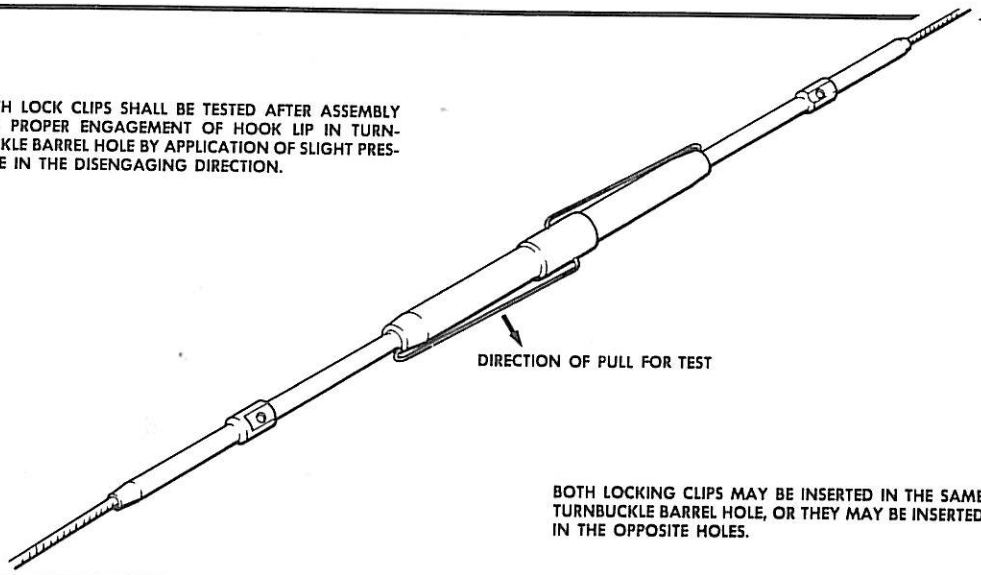
A

**WARNING:** LOCK CLIPS SHALL NOT BE REUSED.



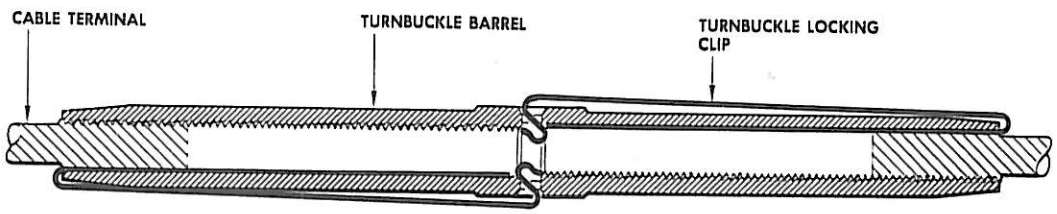

B

BOTH LOCK CLIPS SHALL BE TESTED AFTER ASSEMBLY FOR PROPER ENGAGEMENT OF HOOK LIP IN TURNBUCKLE BARREL HOLE BY APPLICATION OF SLIGHT PRESSURE IN THE DISENGAGING DIRECTION.




BOTH LOCKING CLIPS MAY BE INSERTED IN THE SAME TURNBUCKLE BARREL HOLE, OR THEY MAY BE INSERTED IN THE OPPOSITE HOLES.

C

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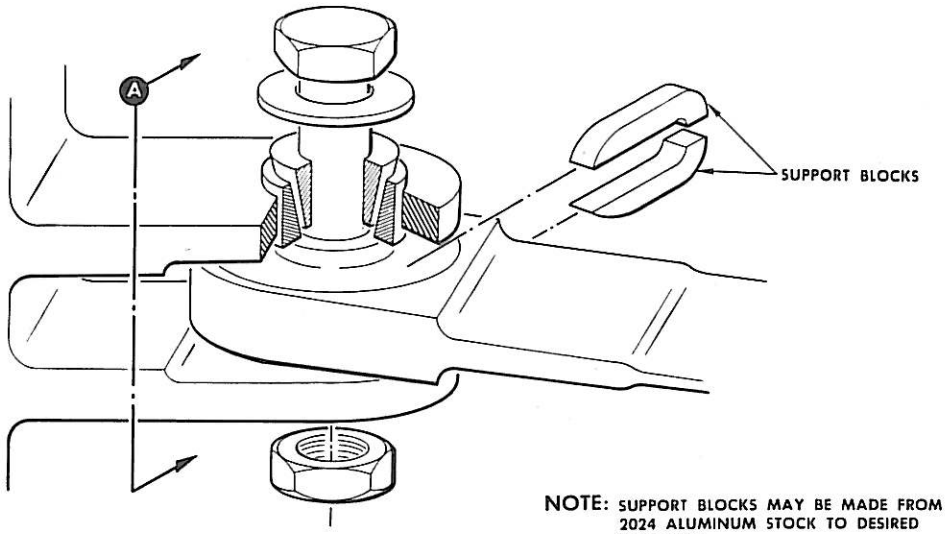
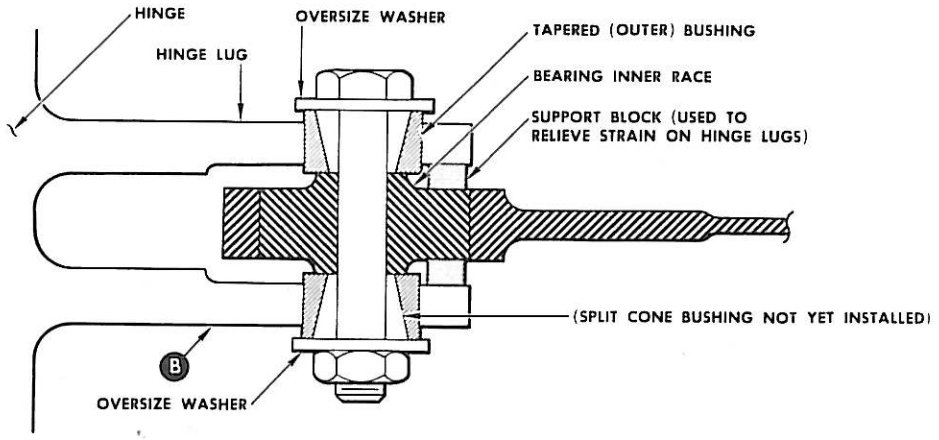


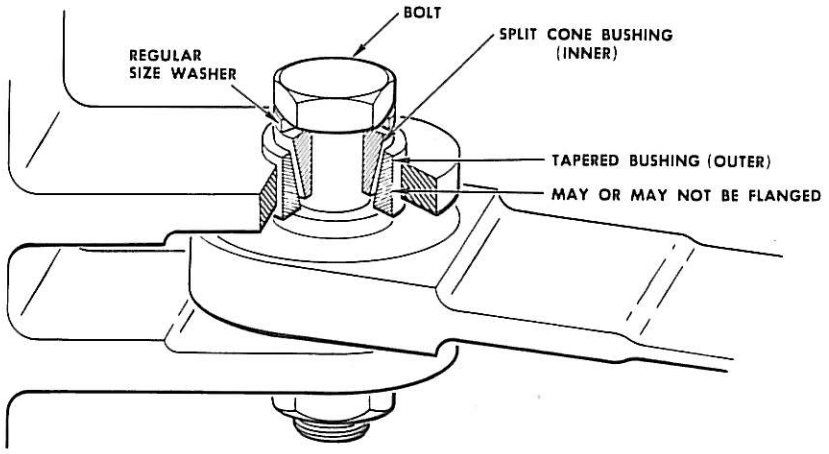

NOTE: SUPPORT BLOCKS MAY BE MADE FROM 2024 ALUMINUM STOCK TO DESIRED THICKNESS

A




TAPERED (OUTER) BUSHINGS DRAWN INTO PLACE BY USE OF OVERSIZE WASHERS

B

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5. Removal/Installation Push-Pull Control Rod Support Rollers - Typical (see Figure 205)

A. General.

Push-pull control rod support rollers are used in various flight control systems. Maintenance procedures for all installation are similar.

B. Equipment Required - Safety wire (MS20995F32 and/or MS20995F47).

C. Remove Control Rod Support Roller.

(1) Loosen bolts securing control rod support fitting to structure and remove safety wire from roller pin and support fitting.

(2) Remove cotter pin from roller pin, remove roller pin and remove roller from support fitting.

D. Install Control Rod Support Roller.

(1) Position roller in support fitting and insert roller pin through fitting and roller.

(2) Install cotter pin in one end of roller pin and safety-wire opposite end of roller pin to support fitting.

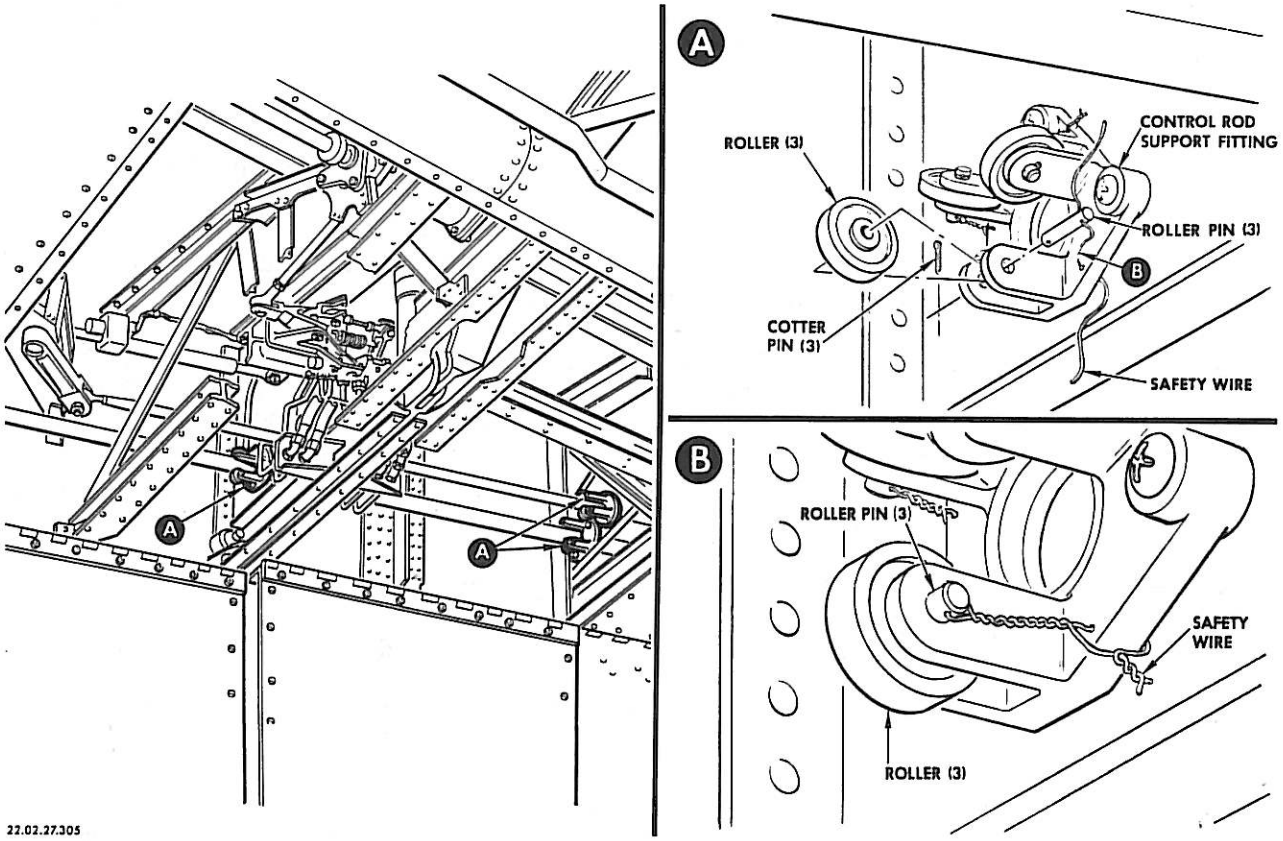
CAUTION: SAFETY WIRE MUST SECURE ROLLER PIN TO SUPPORT FITTING TO PREVENT PIN FROM ROTATING IN FITTING. FAILURE TO COMPLY CAN RESULT IN ELONGATION OF SUPPORT FITTING ROLLER PIN HOLES.

(3) Tighten support fitting attaching bolts.

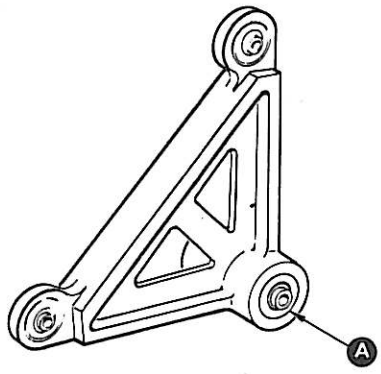
6. Bell Crank Bearing Installation - Typical (see Figure 206)

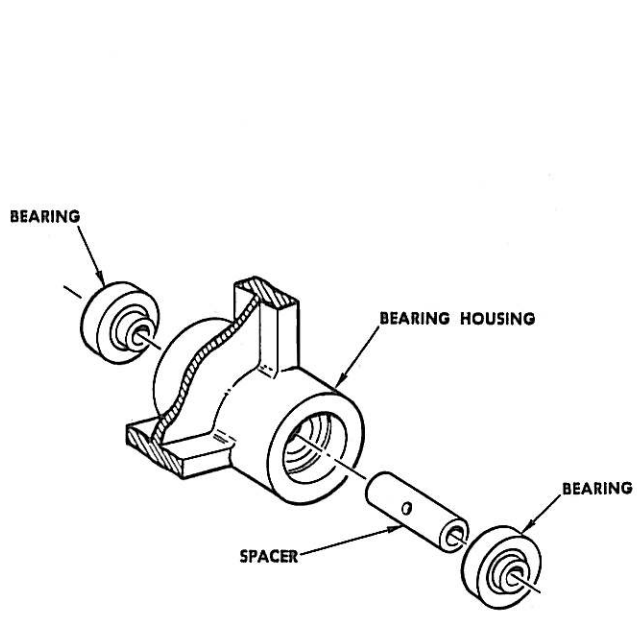
A. General.

Certain fork-type bell cranks in the flight control system contain two bearings in which the inner race of both bearings rotate on a common shaft (bolt). One bearing is a tight "press fit" in its housing, and the other a "sliding fit". This type of assembly permits the bearings to align axially, thereby precluding any binding due to misalignment of the bearings on the shaft. The bearing installation procedure is applicable only to those bell crank assemblies covered in the sections of this manual as indicated in the following list.




Push-Pull Control Rod
Support Rollers Installation - Typical
Figure 205




BELL CRANK ASSEMBLY (TYPICAL)

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| Bell Crank Assembly | Section |
|---|---|
| Aileron Horizontal Bell Crank | 27-1-0 |
| Aileron Vertical Lever Bell Crank | 27-1-0 |
| Aileron Interconnect Inboard Idlers | 27-1-8 |
| Aileron Flight Tab Bell Cranks | 27-1-11 |
| Aileron Hinge Line Bell Cranks | 27-1-12 |
| Aileron Trim Tab Bell Cranks | 27-2-3 |
| Spoiler/Speed Brake Control System, Inboard Idler Assembly | 27-3-0 |
| Spoiler/Speed Brake Control System, Intermediate Idler | 27-3-0 |
| Inboard Spoiler Retract Actuator, Spoiler Interconnect Bell Crank | 27-3-7 |
| Elevator Control Aft "T" Bell Crank | 27-5-10 |
| Elevator Control Idler Bell Crank | 27-5-13 |
| Elevator Control Upper Bell Crank | 27-5-15 |
| Elevator Inboard Bell Crank | 27-5-17 |
| Elevator Flight Tab Bell Crank | 27-5-19 |
| Rudder Power Control Mixer 1 and Mixer 2 | 27-7-0 |
| Rudder Flight Tab Bell Crank | 27-7-3 |
| Rudder Control Aft Bell Crank | 27-7-8 |
| Rudder Control Quadrant Bell Crank | 27-7-10 |
| Rudder "Q" Feel Bell Crank | 27-7-12 |
| Rudder Control Valve Bell Crank | 27-7-14 |

B. Equipment Required.

(1) Ball punch.

(2) Petrolatum, Specification VV-P-236.

C. Install Bearings.

(1) Check loose-fit bearing housing primer paint finish for damage.

NOTE: Bearing housings for loose-fit bearings that have damaged surface finish shall be returned to overhaul for repair and refinishing. (Prime finish is approximately 0.0005-inch thick for loose-fit bearing housing preparation.) If housing has been recently repaired and refinished, ascertain that prime finish is thoroughly dry.

(2) Remove prime coat from press-fit bearing housing and thoroughly clean surface for application of new primer paint.

(3) Coat press-fit bearing housing bore with primer. (Primer finish shall be as specified by manufacturer for protection of bearing housing area of structure.)

(4) While primer is wet in press-fit bearing housing, press bearing into housing, applying an even pressure on bearing outer race only to ensure proper alignment of bearing in housing.

CAUTION: WHEN STAKING BEARING HOUSING IN THE FOLLOWING STEP, STAKE HOUSING BORE LIP ONLY ENOUGH TO PREVENT BEARING FROM FALLING OUT OF HOUSING. STAKE MUST BE ONLY A SLIGHT INDENTION OR DEFORMATION OF THE HOUSING AND NOT ENOUGH TO RADIALLY LOAD OR PINCH THE BEARING IN THE HOUSING.

(5) Stake bearing housing four places with ball punch.

(6) Insert spacer in bore between bearing housings.

(7) Apply coat of petrolatum, Specification VV-P-236, to outside diameter of loose-fit bearing.

(8) Push loose-fit bearing into bearing housing, applying an even pressure on bearing outer race to ensure proper alignment of bearing in housing.

CAUTION: WHEN STAKING BEARING HOUSING IN THE FOLLOWING STEP, STAKE HOUSING BORE LIP ONLY ENOUGH TO PREVENT BEARING FROM FALLING OUT OF HOUSING. STAKE MUST BE ONLY A SLIGHT DEFORMATION OR INDENTION OF THE HOUSING AND NOT ENOUGH TO RADIALLY LOAD OR PINCH THE BEARING IN THE HOUSING.

(9) Stake bearing housing four places with ball punch.

(10) Check bearing break-out torque (refer to Test Bearing Break-Out Torque).

7. Test Bearing Break-Out Torque

A. Equipment Required - Torque wrench calibrated in inch-ounces.

B. Perform Bearing Torque Test.

(1) Insert bolt through inner races of both bearings, secure bolt with washer and nut, and tighten nut to proper torque value. (Bolt shall be same diameter as specified for normal installation in bearings.)

(2) Attach torque wrench to bolt and with no axial loads applied, record break-out force required to rotate bolt and inner races of bearings. Evidence of bearing ratcheting, unevenness of torque or break-out torque in excess of the following shall be cause for rejection of assembly.

| Bolt Size (Nominal) | Break-out Torque (Maximum) |
|---|---|
| 1/2-, 5/16-, 3/8-inch | 2.5 inch-ounces |
| 1/2 inch through 1.0 inch | 5.0 inch-ounces |

(3) Remove nut, washer and bolt from bearing assembly.

# AILERON CONTROL SYSTEM - DESCRIPTION AND OPERATION

## 1. General

Lateral control of the airplane is provided by an aileron and two spoilers at the trailing edge of each wing. The pilot's control wheel is connected through a mechanical linkage with the flight tab on each aileron. The co-pilot's control wheel is likewise connected through a speed brake/spoiler mixer with four servo valves which control the flow of hydraulic fluid to the spoiler actuators. The aileron and spoiler systems and the two control wheels are connected by a spring-loaded crossover tube beneath the flight compartment floor. The two ailerons are connected by an interconnect linkage to prevent up-float or down-float during flight. The linkages comprising the aileron and spoiler systems are shown in Figure 1.

A cam and spring assembly in the speed brake/spoiler mixer provides artificial feel for the aileron and spoiler systems. The autopilot aileron servo is connected to the spoiler linkage and operates the ailerons indirectly through the spring-loaded crossover tube.

A gust damper connected to each aileron prevents sudden aileron movements and provides up and down stops for the ailerons. The gust dampers are adjusted so that the gust damper pistons bottom out when the ailerons are at the full deflected position.

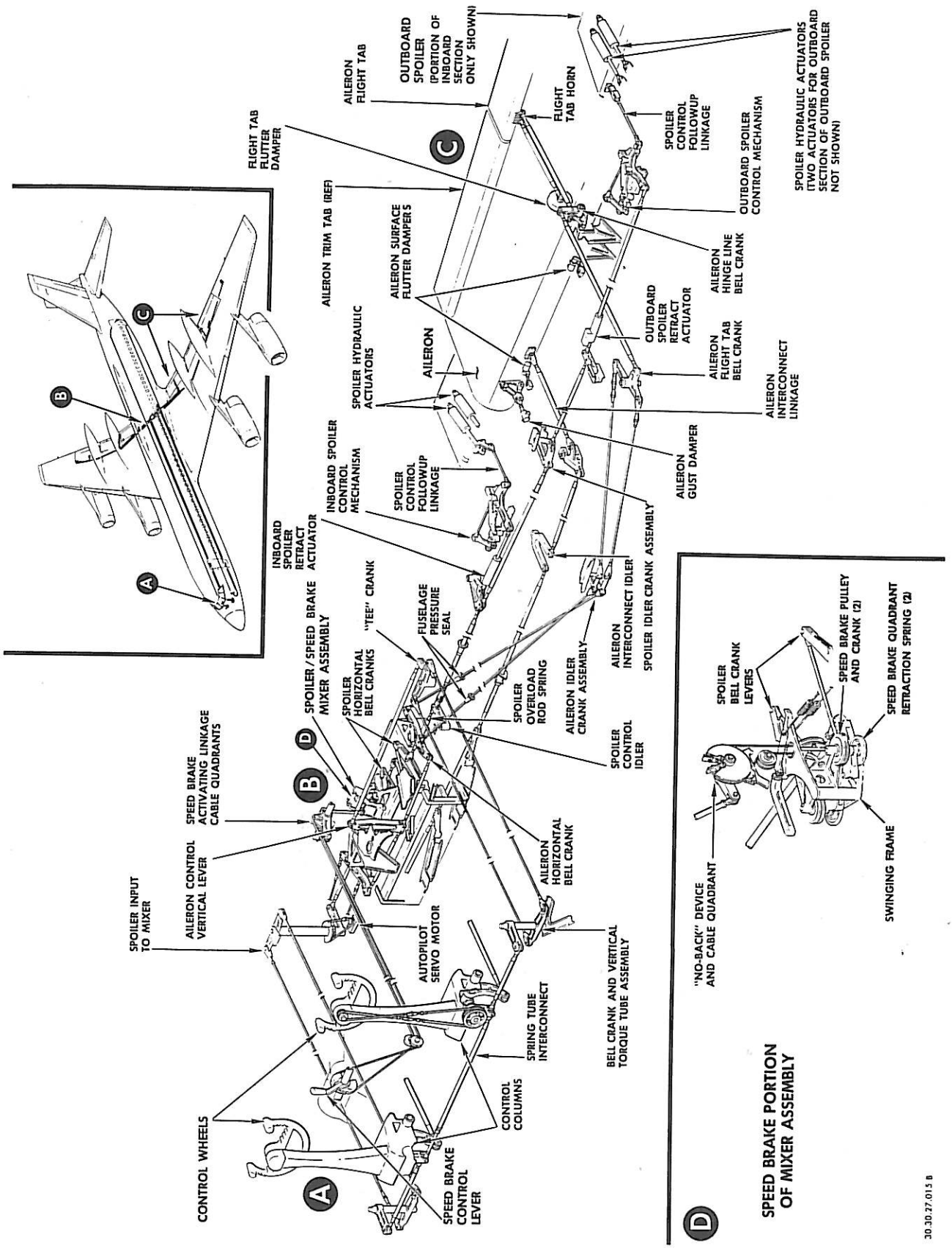
## 2. Ailerons

The ailerons are located between the inboard and outboard flaps on each wing (see Figure 2). They are supported by the wing rear spar through forged ribs containing hinge fittings. Five hinges, two at the outboard end, two at the center and one at the inboard end of the aileron, attach the aileron to the wing structure. This method of attachment provides three-hinge support with fail-safe double hinges at the outboard and center locations. Weights are attached to the aileron leading edge to provide static balance. Aerodynamic balance is obtained by a sealed fabric balance curtain between the aileron leading edge and wing rear spar. For a description of the aileron structure, refer to Chapter 57, WINGS.

## 3. Aileron and Aileron Flight Tab Travel

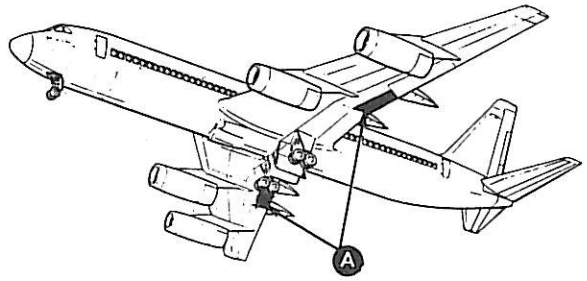
The ailerons are rigged from a position streamline with the wings. Aileron travel from streamline is 15 $\binom{+1.0}{-0.5}$ degrees trailing edge "up" and 15 $\binom{+1.0}{-0.5}$ degrees trailing edge "down".

Flight tab travel is 20 (±0.5) degrees trailing edge "up" and "down". Stops on the aileron hinge line bellcranks limit flight tab travel.

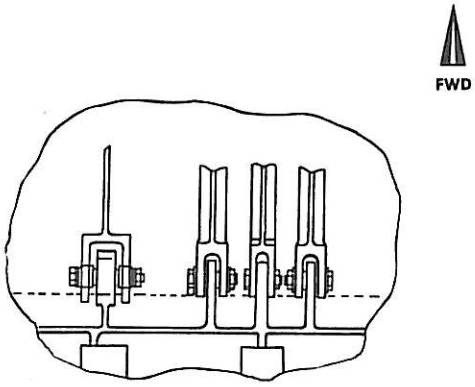





Aileron and Spoiler Control Systems
Figure 1

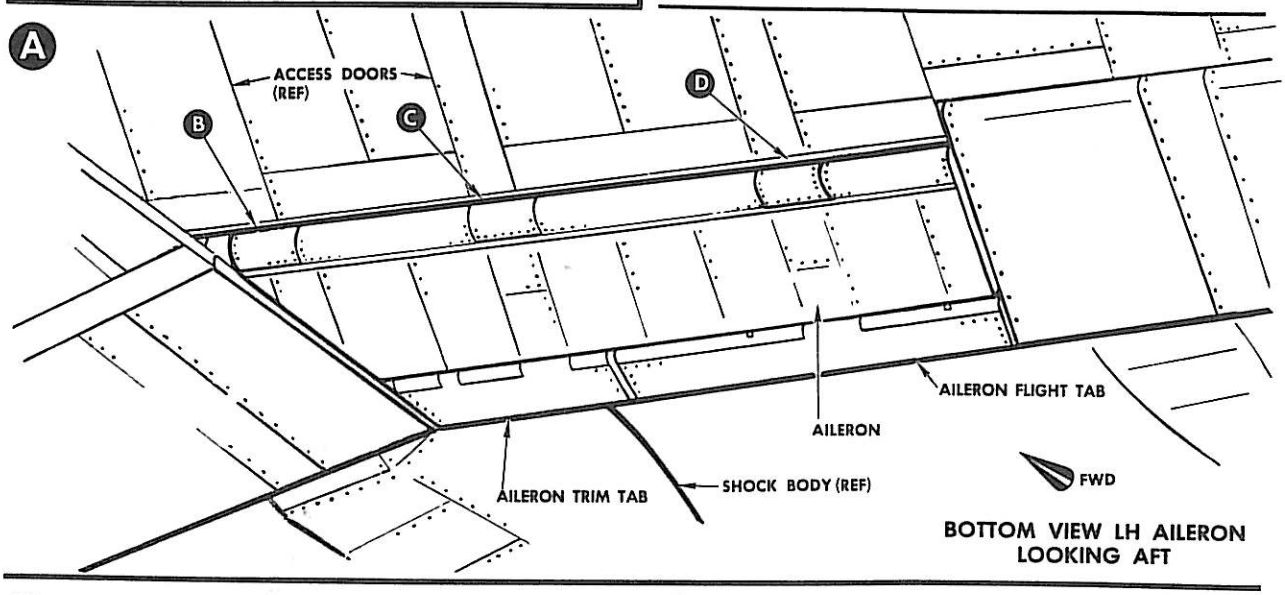



B



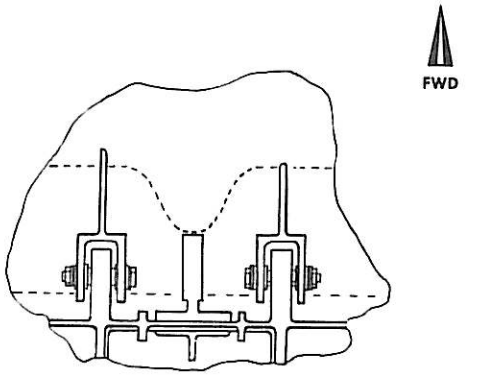

AILERON INBOARD ATTACHMENT

A



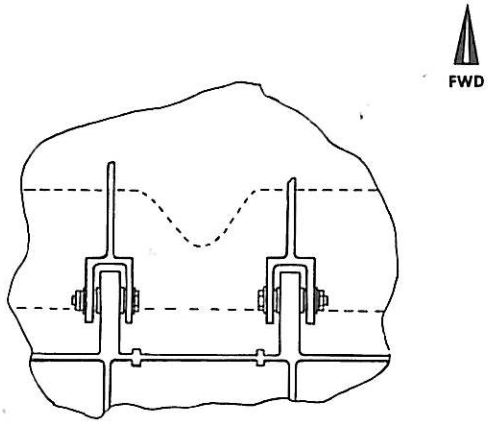

BOTTOM VIEW LH AILERON LOOKING AFT

C




AILERON CENTER ATTACHMENT

D




AILERON OUTBOARD ATTACHMENT

30.30.27.017

4. Aileron Control and Operation

The two side-by-side control columns in the flight compartment are of conventional design. Fore and aft movement of the columns controls the elevator system and rotation of the control wheels imparts motion to the aileron and spoiler systems.

A cable system in each control column connects the control wheels with a quadrant and double crank assembly at the base of their respective columns. A spring-loaded crossover tube, set for a breakout force of 39 pounds at either control wheel, interconnects the forward cranks of the two control column quadrants. A push-pull rod connects the aft crank on each control column quadrant assembly with a bell crank assembly mounted outboard of each control column.

A force exerted on the control wheel is transmitted through the control column cable system to the quadrant and crank assembly. The two cranks on the quadrant and crank assembly divide this control wheel force and transmit it through the push-pull rods and spring-loaded tube assembly to the bell cranks on each side of the airplane. These bell cranks transfer the push-pull rod motion to the dual cable systems on each side of the airplane under the cabin floor. This motion is carried through the cable systems to their respective bell crank and bracket installations in the mixer area. The mixer is located on the forward bulkhead of the hydraulic compartment.

The aileron aft bell crank is on the left side of the airplane in the mixer area and transmits the motion from the left-hand dual cable assembly to the aileron control vertical lever ahead of the mixer by means of a push-pull rod. The spoiler aft bell crank is on the right side of the airplane. It transmits spoiler control motion from the right-hand dual cables through a torque tube and bell crank assembly to the swinging frame in the mixer. (For a detailed description of the spoiler system, (refer to 27-3-0.)

Push-pull rods, attached to the lower end of the aileron vertical lever, connect the aileron horizontal bell cranks on each side of the mixer. The aileron wing cable systems attach to these bell cranks (see Figure 3). Thus, aileron control forces from the control wheels are transmitted through the fuselage and out into the wings to the aileron flight tab bell cranks. An aileron idler in each wing provides for a directional change of cable routing to conform with the sweepback of the wing.

The bell crank at the end of each wing cable system receives aileron control motion from the cables and transmits it, through a push-pull rod to an additional bell crank located on the aileron hinge line. The aileron hinge line bell crank is pivoted on wing structure and provided with adjustable stops to limit flight tab travel. From the aileron hinge bell crank an additional rod transmits aileron system motion to the flight tab. The flight tab horn is dual to provide for a second rod that attaches to a flight tab flutter damper.

AILERON/SPOILER MIXER
SPOILER INPUT TO MIXER (REF)
AILERON VERTICAL LEVER
AILERON INPUT TO MIXER
AILERON HORIZONTAL BELL CRANK (2)
D
A
B
C
AILERON TRIM TAB (REF)
AILERON FLIGHT TAB FLUTTER DAMPER
AILERON FLIGHT TAB
AILERON FLIGHT TAB HORN
AILERON HINGE LINE BELL CRANK
AILERON INTERCONNECT OUTBOARD IDLER CRANK
AILERON SURFACE FLUTTER DAMPER (2 EACH AILERON)
AILERON FLIGHT TAB BELL CRANK
AILERON GUST DAMPER
OUTBOARD INTERCONNECT BELL CRANK
AILERON IDLER ASSEMBLY
AILERON CONTROL HORIZONTAL BELL CRANK (2)
AILERON CONTROL AFT BELL CRANK
FUSELAGE PRESSURE SEALS
AILERON INTERCONNECT INBOARD IDLER CRANK
PILOT'S CONTROL WHEEL (AILERON INPUT)
SPOILER CONTROL BELLCRANK TORQUE TUBE AND QUADRANT ASSEMBLY
AILERON CONTROL VERTICAL LEVER
AILERON CONTROL FORWARD BELL CRANK
AILERON AUTOPILOT SERVO MOTOR
ELEVATOR CONTROL (REF)
COPILOT'S CONTROL WHEEL (SPOILER INPUT)
CONTROL COLUMN UPPER CABLE QUADRANT
SPOILER CONTROL FORWARD BELL CRANK
SPRING-LOADED CROSSOVER TUBE
CONTROL COLUMN LOWER CABLE QUADRANT AND CRANK ASSEMBLY
.30.30.27.016 B

As the control wheels are connected to the aileron flight tabs rather than to the aileron surfaces, iced or jammed ailerons might go undetected during the preflight controls check. This possibility is precluded by the installation of a striker on the upper end of each aileron hinge line bell crank and a matching mechanical stop on the aileron front spar. When the control wheels have been rotated to the right 63 degrees, the left aileron flight tab is deflected upwards 2/3 of its total travel. Continued right rotation of the pilot's control wheel extends the override spring connecting the aileron and spoiler forward bell cranks, and causes the striker on the left aileron hinge line bell crank to contact the stop on the left aileron. When the pilot's control wheel reaches 90 degrees (full travel), the flight tabs will have been driven to their full travel position and the ailerons will be deflected approximately 7 1/2 degrees from streamline. The right aileron will be deflected upward simultaneously by the aileron interconnect linkage. Rotating the pilot's control wheel 90 degrees to the left lowers the right and raises the left aileron. Because the ailerons deflect in the opposite direction to that in which the flight tabs are deflected inflight, the stops on the aileron move away from the hinge line bell crank strikers without making contact.

Balance panels form the leading edge of each aileron. Balance weights are attached to the balance panels. The balance panels assist the pilot in moving the ailerons. The balance weights position the CG of the aileron assembly forward of the aileron hinge line. Curtains are installed between the balance panels and the wing trailing edge structure to seal off the areas above and below the panels.

5. Aileron Interconnect System

The aileron interconnect system prevents "up-float" and "down-float" of the ailerons and provides a means of evenly distributing loads applied to the ailerons.

A fitting attached to the aileron at the hinge line is connected by a rod to a horizontal bell crank mounted on the wing structure. From this bell crank a push-pull tube extends inboard to a flexible wishbone shaped idler crank, located approximately mid-way between the aileron location and the fuselage. The flexible idler crank deflects appreciably under load, relieving the ailerons of a portion of their high symmetrical loading. This relieves forces on the airplane's structure and on the aileron interconnect system.

From this idler a push-pull tube extends inboard to an idler beneath the speed brake/spoiler mixer assembly. Roller assemblies are spaced along the tube to support the tube and to allow freedom of movement. A seal is located at a point where the inboard tube passes through the fuselage to prevent loss of cabin pressurization. An idler on the opposite side of the mixer transmits interconnect motion to the other aileron. The two center idlers are connected by a control rod below and aft of the mixer.

6. Aileron Flight Tabs

The aileron flight tabs are attached to the outboard trailing edge of the ailerons at three points, with dual hinges at the center hinge point location. Each flight tab is statically balanced with counterweights in the leading edge. For a description of the aileron flight tab structure, refer to Chapter 57, WINGS.

7. Aileron Gust Dampers

A. Description.

Two aileron gust dampers, one for each aileron, protect the ailerons from damage due to high winds when the airplane is on the ground and resist any rapid movement of the ailerons during flight. The gust dampers also serve as stops to limit the deflection of the ailerons. The dampers do not appreciably affect the movement of the ailerons under normal operating conditions.

Each gust damper consists essentially of a cylinder-reservoir assembly, a ported piston, and an adjustable piston rod. The cylinder is pivoted on bearings located in brackets attached to the wing structure near the inboard end of the aileron. The aft end of the piston rod is connected to a clevis at the forward end of an "A" frame attached to the front spar of the aileron and extending well ahead of the aileron hinge line.

The gust damper cylinder is kept filled with hydraulic fluid by a spring-loaded piston located in one end of the reservoir. A ball check valve prevents a return flow from the cylinder back to the reservoir. The gust damper assembly is equipped with a filler cap, a bleed plug and a sight gage for servicing.

B. Operation.

Due to the location of the "A" frame ahead of the aileron hinge line, any movement of the aileron surface will rock the "A" frame in the opposite direction, increase or decrease the distance between the "A" frame clevis and the gust damper pivots, and extend or retract the gust damper piston rod. When the aileron is in the streamline position, the gust damper piston rod is retracted. The length of the piston rod is adjusted so that the piston rod is fully extended and the piston is bottomed out against the aft end of the cylinder when the aileron is fully deflected.

The maximum rate at which the ailerons can be moved is governed by the rate at which the hydraulic fluid in the gust damper cylinders can pass from one side of the pistons to the other side through the piston ports. The ports are large enough to allow free movement of the ailerons at a normal rate of deflection and yet small enough to resist any rapid aileron movement and cushion the impact effect as the ailerons approach the angle of maximum deflection.

8. Aileron Surface Flutter Dampers

A. Description.

The ailerons are protected against any flutter tendency by four hydraulic dampers, one located at the inboard end, another at the outboard end of each aileron. The flutter dampers are mounted on the front spar of the aileron in line with the aileron hinge line.

Each flutter damper consists essentially of a hollow cylinder, a hollow shaft with a protruding splined end, a damper arm with a serrated hole that fits over the splined end of the shaft, a reservoir for a reserve supply of hydraulic fluid, and a spring-loaded piston located in one end of the reservoir. The space between the cylinder wall and the outside of the hollow shaft is divided into six separate chambers by three stators integral with the cylinder wall and three vanes attached to the damper shaft. Each of these chambers is connected to the cavity in the center of the shaft by a metering passage. The damper arm is attached to the wing structure to keep the shaft from turning when the ailerons are deflected.

The spring-loaded piston forces fresh hydraulic fluid from the reservoir into the center of the damper shaft as needed. Each damper is provided with a sight gage and filler cap for servicing.

B. Operation.

When the ailerons are deflected in either direction, the flutter damper cylinders are rotated about the flutter damper shafts. As the cylinder stators move in relation to the shaft vanes, the chambers ahead of the stators are decreased in size and hydraulic fluid is forced through the metering passages into the center of the shaft. Simultaneously, hydraulic fluid flows from the center of the shaft through the remaining metering passages into the enlarging chambers behind the stators.

The rate at which the ailerons can be deflected is governed by the size of the metering passages. These passages are large enough to permit unobstructed normal operating movements and yet small enough to dampen any sudden aileron movement such as would occur if a flutter tendency should develop.

9. Aileron Flight Tab Flutter Dampers

Each aileron flight tab is protected against any flutter tendency by a rotary hydraulic flutter damper mounted on a bracket aft of the aileron front spar. The arm of the flutter damper is attached to the forward end of a push-pull rod extending aft to the outboard flight tab horn. When the aileron flight tabs are deflected, the control and push-pull rods rotate the flutter damper shafts within the flutter damper cylinder. The resistance of the flutter damper to any sudden rotation of the damper shaft effectively dampens any flutter which might develop.

The flight tab flutter damper is similar to and operates on the same principle as the aileron surface flutter dampers.

## AILERON CONTROL SYSTEM - TROUBLE SHOOTING

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 1. EXCESSIVE FORCE REQUIRED TO ROTATE CONTROL WHEELS | |
| A. Excessive tension in aileron or spoiler cable systems. | Check tension of aileron fuselage and wing cables. Tension should be 205 (±25) pounds at 70 degrees F (20 degrees C). Temperature correction factor is 1 pound for each degree F (2 pounds for each degree C) increase or decrease in temperature. Correct tension if incorrect.<br><br>Check tension of control column cable systems with spring scale. Attach scale to turnbuckle in control column cable and check that a scale force of 25 (±2.0) pounds deflects turnbuckle 0.70 (+0.3, -0.35) inch. Correct tension if incorrect. |
| B. Excessive frictional drag in aileron or spoiler system components. | If tensions of all cable systems are within specified tolerances, isolate malfunction by disconnecting push-pull rods at aileron and spoiler aft bell cranks, outboard of mixer. If control wheels do not move freely, malfunction is in spoiler or aileron control system ahead of mixer. If control wheels move freely, malfunction is in mixer or in one or more components in aileron or spoiler system in wings.<br><br>If moving aileron vertical lever in mixer requires excessive force, malfunction is in aileron system; if moving swinging frame in mixer requires excessive force, malfunction is in spoiler system. If malfunction is in spoiler system, refer to 27-3-0, SPOILER CONTROL SYSTEM - TROUBLE SHOOTING. |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 1. EXCESSIVE FORCE REQUIRED TO ROTATE CONTROL WHEELS (CONT) | |
| C. Excessive friction in aileron or spoiler system components forward of mixer. | If control wheels do not move freely when aileron and spoiler push-pull rods have been disconnected from aft bell cranks, isolate faulty aileron or spoiler forward control system by disconnecting spring crossover tube from bell crank at base of either control column and check control wheels for free rotation. Disconnect push-pull rod from top of forward bell crank of faulty system and check control wheel for free rotation. If control wheel does not rotate freely, loosen control column control cables and isolate defective unit as control wheel bearing or control column lower cable bell crank bearing. Replace defective unit.<br><br>If control wheel rotates freely, loosen fuselage control cables and isolate malfunction as defective bearing in forward or aft bell crank. Replace defective bell crank. |
| D. Excessive friction in mixer or aileron control system in wings. | If excessive force is required to move aileron vertical lever in mixer with push-pull rod disconnected from aileron aft bell crank, isolate defective section of aileron control system by disconnecting push-pull rod from lower end of aileron vertical lever and from right and left aileron horizontal bell cranks. Test lever and bell cranks for excessive friction.<br><br>If vertical lever does not rotate freely, replace lever. If vertical lever rotates freely, isolate malfunction in left or right aileron control system. |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 1. EXCESSIVE FORCE REQUIRED TO ROTATE CONTROL WHEELS (CONT) | |
| E. Excessive friction in aileron wing components. | Disconnect push-pull rods from aileron flight tab bell crank in malfunctioning system and isolate malfunction between control cable or push rod components. If push-pull rods do not move freely, isolate malfunction in hinge line bell crank or flight tab hinges. Replace or repair faulty unit as indicated. If aileron horizontal bell crank of faulty system does not rotate freely, loosen cables and isolate defective bell crank or idler. Replace faulty unit as indicated.<br><br>WARNING: WHEN AN ADJUSTMENT IS CHANGED OR A COMPONENT REPLACED IN THE AILERON CONTROL SYSTEM, A FUNCTIONAL TEST MUST BE PERFORMED. REFER TO ADJUSTMENT/TEST ADJUST AILERON SYSTEM. |
| 2. FORCE REQUIRED TO MOVE AILERONS WITH SPRING SCALE (GROUND CHECK) NOT WITHIN TOLERANCES DESIGNATED IN FUNCTIONAL TEST PROCEDURE | |
| A. Broken or disconnected aileron interconnect linkage. | Beginning at the aileron interconnect attachment at either aileron, check for broken or disconnected push-pull tubes or cranks at the aileron interconnect outboard bell crank, aileron interconnect idler crank in the wing, and the aileron interconnect idlers beneath the mixer. Check both wings and correct faulty linkage. |
| B. Interconnect linkage binding. | Insert index pins 22-J107-2.37 in interconnect outboard bell cranks and index pins 22-J107-3.00 in left and right aileron hinge line bell cranks. Disconnect push-pull rods connecting interconnect bell cranks to ailerons. |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|

2. FORCE REQUIRED TO MOVE AILERONS WITH SPRING SCALE (GROUND CHECK) NOT WITHIN TOLERANCES DESIGNATED IN FUNCTIONAL TEST PROCEDURE (CONT)

Using a spring scale, move each aileron from trailing edge "up" position to trailing edge "down" position, then back to "up" position. (Note forces required to move each aileron through complete travel.)

NOTE: If forces required to move one aileron exceed forces required to move opposite aileron, the malfunction is in the hinge fittings or gust damper of the aileron requiring excessive force (refer to paragraph C.). If both ailerons can be deflected by approximately the same amount of force, the malfunction is in the aileron interconnect linkage.

Disconnect push-pull tubes at interconnect idlers beneath mixer and remove index pins from interconnect outboard bell cranks.

Move idlers beneath mixer and check for signs of binding. If either idler is binding, repair or replace idler. If idlers are not binding, grasp push-pull rods disconnected from idlers and move linkage in each wing inboard and outboard. In linkage requiring excessive force, disconnect push-pull tubes from aileron interconnect idler (see Figure 201) and rotate idler to check for binding. If binding, repair or replace idler.

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 2. FORCE REQUIRED TO MOVE AILERONS WITH SPRING SCALE (GROUND CHECK) NOT WITHIN TOLERANCES DESIGNATED IN FUNCTIONAL TEST PROCEDURE (CONT) | |
| | If not binding, reconnect push-pull tubes to idlers and disconnect push-pull tube from inboard side of interconnect outboard bell crank. Repair or replace interconnect outboard bell crank as necessary.<br><br>When malfunction has been corrected, adjust aileron interconnect linkage (refer to Adjustment/Test Adjust Aileron System, Paragraph 1.E). Remove all surface tools and index pins. |
| C. Aileron hinge fittings or gust damper attachments binding. | If forces required to move one aileron through complete travel are excessive with interconnect linkage disconnected from aileron (refer to paragraph 1.B.) proceed as follows:<br><br>With index pins installed in aileron hinge line bell cranks, move malfunctioning aileron through complete travel. Listen at gust damper linkage and at aileron hinge locations for binding. If binding can be traced, repair or replace faulty component. If binding can not be traced, disconnect gust damper at aileron "A" frame.<br><br>Operate gust damper through extension and retraction cycles. If gust damper binds, replace gust damper. |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 2. FORCE REQUIRED TO MOVE AILERONS WITH SPRING SCALE (GROUND CHECK) NOT WITHIN TOLERANCES DESIGNATED IN FUNCTIONAL TEST PROCEDURE (CONT) | |
| | If gust damper action is smooth, check main balance seals for binding. If binding, repair as necessary (refer to Removal/Installation Aileron Main Balance Seals).<br><br>If main balance seals not binding, malfunction is in one or more of the aileron hinge attachments. Disconnect and check each hinge fitting until malfunction is located; repair or replace as necessary.<br><br>When trouble shooting is complete, reconnect hinge fittings (refer to Removal/Installation Ailerons). Connect gust damper rod end to aileron "A" frame (refer to Removal/Installation Aileron Gust Damper). Connect aileron interconnect linkage.<br><br>NOTE: If aileron interconnect linkage has been disturbed, rerig aileron interconnect system (refer to Adjustment/Test Adjust Aileron System Paragraph 1.E., Adjust Aileron Inter-connect system).<br><br>After trouble shooting has been completed, perform a functional test of the aileron control system (refer to Adjustment/Test Aileron System Functional Test). |
| 3. AILERONS ARE NOT STREAMLINED WITH WINGS DURING HIGH SPEED FLIGHT | |
| A. Improper amount of aileron droop. | If ailerons ride above wings during high speed flight, disconnect aileron interconnect push-pull rods from aileron interconnect horns, shorten push-pull rods as necessary, and re-install. |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 3. AILERONS ARE NOT STREAMLINED WITH WINGS DURING HIGH SPEED FLIGHT (CONT) | |
| | If ailerons ride below wings during high speed flight, lengthen interconnect push-pull rods as necessary to correct excessive droop. |
| | Final position of ailerons must be from 1.5 degrees down to 0.5 degree up (ailerons symmetrical). |

## AILERON CONTROL SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test Adjust Aileron System (see Figure 201)

A. General.

The aileron and spoiler systems are adjusted separately; however, before adjusting either system from the mixer assembly through the wing, it will be necessary to adjust the related aileron or spoiler cables in the fuselage from the flight compartment to the mixer assembly.

B. Aileron and Aileron Flight Tab Travel Data (see Figure 202).

Angular measurements are taken with a protractor installed on the trailing edge of the control surface or the flight tab. A linear measurement is the straight line distance in inches between the noted point on the surface in the streamline position and the same point on the surface in the deflected position.

C. Equipment Required.

(1) Specially calibrated tensiometer for measuring tension of 1/8-inch 1 x 19 cables.

(2) Thermometer calibrated in degrees F or C.

(3) Protractors No. 30-18001-1 and -2 for measuring aileron deflection.

(4) (Deleted.)

(5) Rigging tools No. 30-44416-901 and -902 for locking aileron hinge line bell cranks.

(6) Spring scale calibrated from 0 to 30 pounds.

(7) Straight edge at least 4 feet long for streamlining ailerons with wing and flight tabs with ailerons.

(8) Check gage No. 30-18001-903 and -904 to measure flight tab deflection.

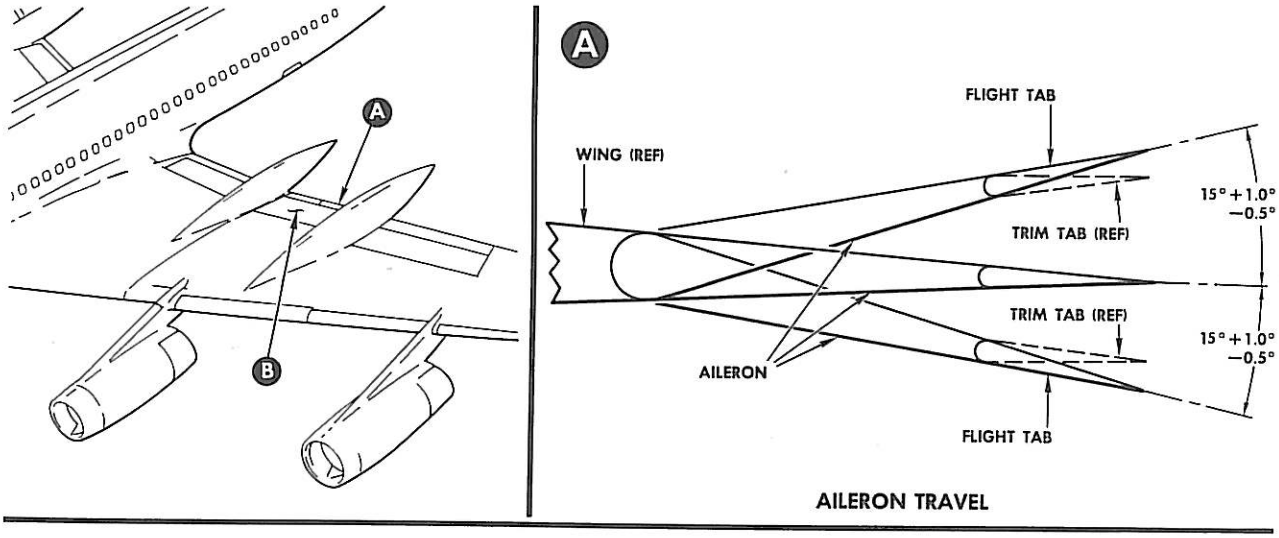
(9) The following or equivalent index pins:

(a) Three 22-J107-2.0

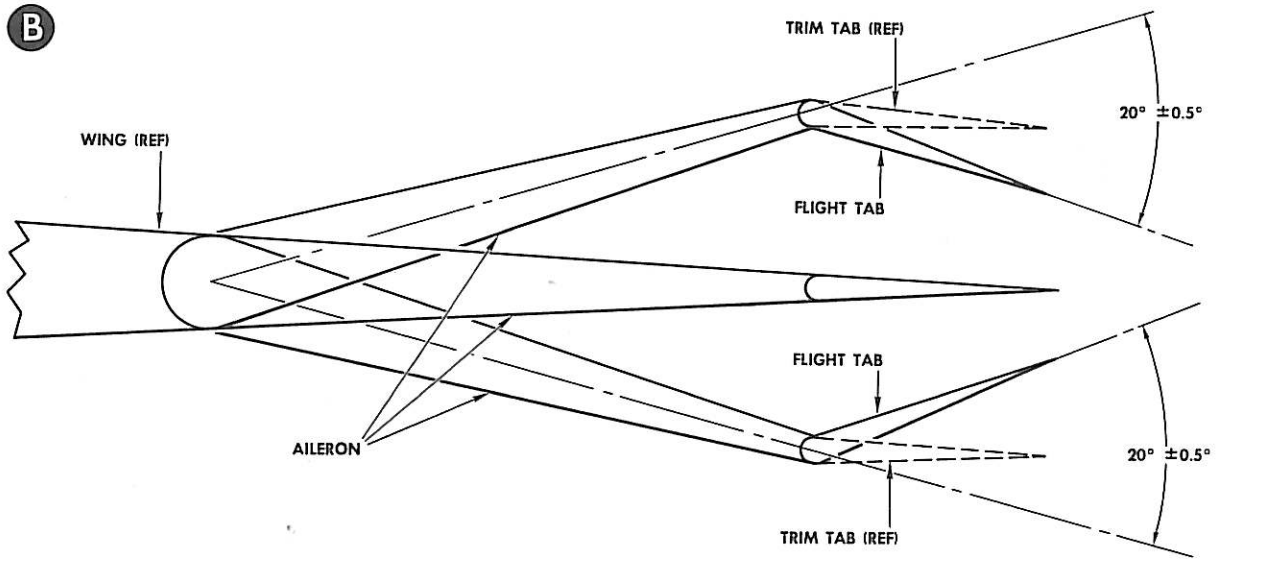
(b) Two 22-J107-2.5

(c) Two 22-J107-3.0

AILERON LINKAGE THROUGH MIXER
SPOILER INPUT TO MIXER (REF)
AILERON VERTICAL LEVER
AILERON INPUT TO MIXER
AILERON HORIZONTAL BELL CRANK (2)
D
A
B
C
AILERON TRIM TAB (REF)
AILERON FLIGHT TAB FLUTTER DAMPER (1 EACH AILERON)
AILERON FLIGHT TAB
INDEX PIN (REF)
AILERON FLIGHT TAB HORN
AILERON HINGE LINE BELL CRANK
AILERON INTERCONNECT OUTBOARD IDLER CRANK
AILERON GUST DAMPER
AILERON SURFACE FLUTTER DAMPER (2 EACH AILERON)
OUTBOARD INTERCONNECT BELL CRANK
INDEX PIN (REF)
AILERON FLIGHT TAB BELL CRANK
AILERON CONTROL HORIZONTAL BELL CRANK (2)
AILERON CONTROL AFT BELL CRANK
FUSELAGE PRESSURE SEALS
AILERON IDLER ASSEMBLY
INDEX PINS (REF)
AILERON CONTROL VERTICAL LEVER
INDEX PIN (REF)
AILERON INTERCONNECT INBOARD IDLER CRANK
PILOT'S CONTROL WHEEL (AILERON INPUT)
SPOILER CONTROL BELLCRANK TORQUE TUBE AND QUADRANT ASSEMBLY
INDEX PIN (REF)
AILERON AUTOPILOT SERVO MOTOR
ELEVATOR CONTROL (REF)
INDEX PIN (REF)
AILERON CONTROL FORWARD BELL CRANK
COPILOT'S CONTROL WHEEL (SPOILER INPUT)
CONTROL COLUMN UPPER CABLE QUADRANT
INDEX PIN (REF)
INDEX PIN (REF)
SPRING-LOADED CROSSOVER TUBE
CONTROL COLUMN LOWER CABLE QUADRANT AND CRANK ASSEMBLY
SPOILER CONTROL FORWARD BELL CRANK
30.02.27.045 B




AILERON TRAVEL




AILERON FLIGHT TAB TRAVEL

| | | ANGULAR | |
|---|---|---|---|
| | | UP | DOWN |
| AILERON TRAVEL | FULL AILERON | 15° +1.0° −0.5° | 15° +1.0° −0.5° |
| AILERON FLIGHT TAB TRAVEL | FULL AILERON | 20° ±0.5° | 20° ±0.5° |

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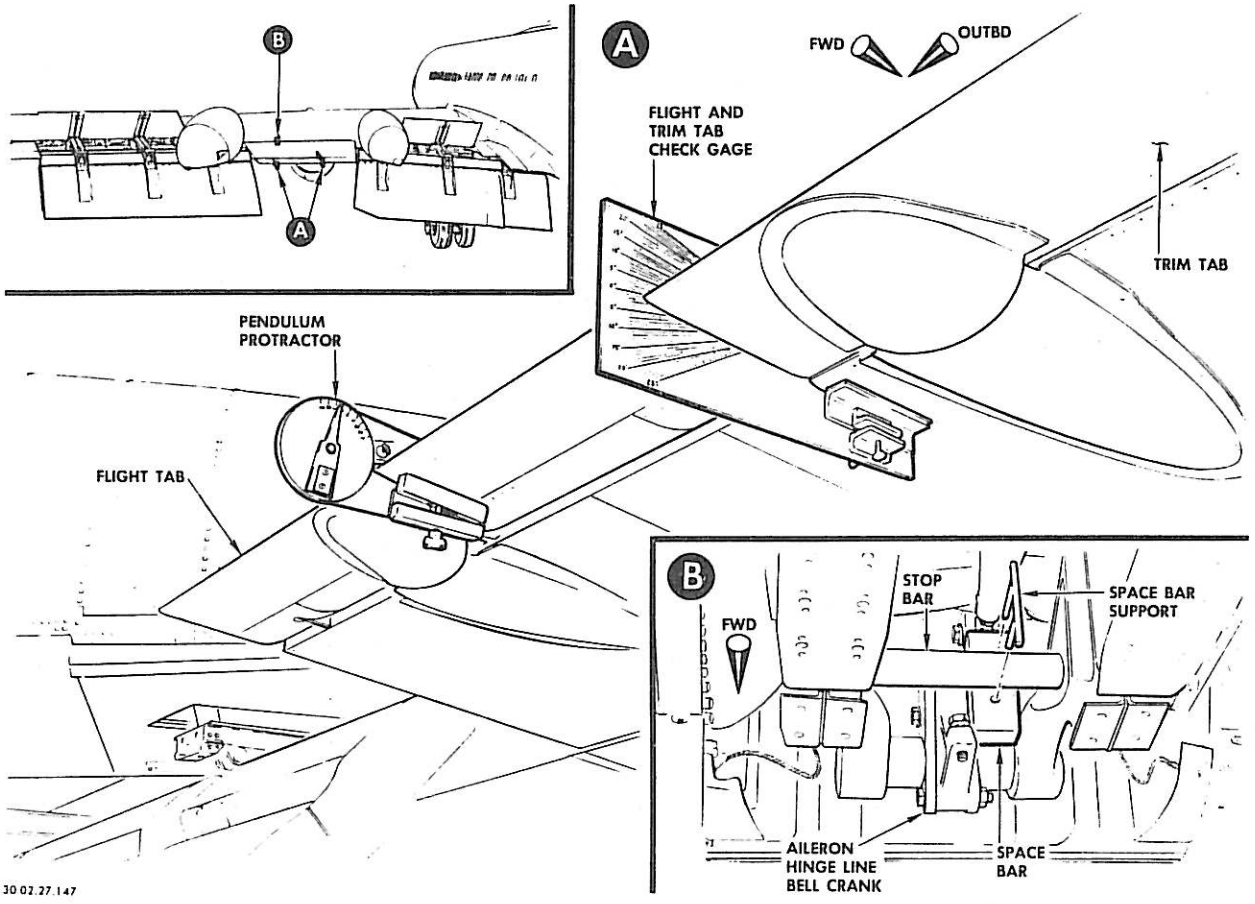





Aileron Rigging Tool Installation
Figure 203

(d) Three 22-J107-4.0

(e) Two 22-J107-5.0

D. Adjust Aileron and Spoiler Systems From Flight Compartment to Aft Aileron and Spoiler Bell Cranks.

(1) Place control column in neutral position and install index pin 22-J107-210 in elevator LH forward "T" bell crank.

(2) Disconnect control rod from spoiler aft bell crank assembly.

(3) Disconnect control rod from aileron aft bell crank.

(4) At base of each control column, insert index pin 22-J107-5.00 in control column lower cable quadrants.

(5) If index pins cannot be inserted, disconnect spring-loaded crossover tube, insert index pins, and adjust tube to length between rigged cable quadrants. Connect crossover tube and torque rod end lock nut between 95 and 110 inch-pounds.

(6) Remove access door from pilot's control column, attach spring scale to turnbuckle in aileron control column cable, and check that a spring scale force of 25 (±2.0) pounds deflects turnbuckle 0.70 (+0.03, -0.35) inch. If not, adjust tension of control column cables as necessary to bring spring scale force and cable deflection within tolerance.

(7) Check that pilot's control wheel is centered. If not, loosen turnbuckle in one control column cable and tighten turnbuckle in opposing cable as necessary to center control wheel. Recheck tension of cables and install NAS651 clips.

(8) Repeat steps (6) and (7) substituting copilot for pilot.

(9) Attempt to insert index pins 22-J107-2.50 in aileron forward bell crank and spoiler forward bell crank.

(10) If index pins cannot be inserted, disconnect rods inboard of bell cranks. Insert index pins, adjust rods to length between rigged bell cranks and rigged control column quadrant arms and reinstall. Tighten rod end lock nuts. Remove index pins from control column cable quadrants.

(11) Check that tension of aileron and spoiler fuselage cables is 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature. If tension of cables is not within tolerance, tighten turnbuckles in opposing cables equally to obtain proper tension.

(12) In the hydraulic compartment outboard of the mixer (RH and LH), attempt to insert index pins 22-J107-2.0 through aileron and spoiler aft bell cranks.

(13) If index pins cannot be inserted, tighten turnbuckle in one cable and loosen turnbuckle in opposite cable until index pins can be inserted. If cables require adjustment, recheck cable tension. Safety all turnbuckles with NAS651 clips and remove index pins from forward bell cranks.

E. Adjust Aileron Interconnect System.

NOTE: Airplane shall be resting on landing gear and fuel tanks shall be empty for the following adjustments.

(1) Open appropriate shroud doors in under surface of wings to gain access to aileron flight tab and interconnect linkage units.

(2) Using straight edge, locate and secure LH aileron in streamline position.

(3) Attempt to insert index pin 22-J107-3.00 through aileron LH outboard interconnect bell crank. If index pin cannot be inserted, disconnect push-pull rod from outboard arm of bell crank, insert index pin in bell crank, adjust length of push-pull rod to rigged bell crank and aileron horn, tighten check nut on rod end, and install push-pull rod on bell crank.

(4) Attempt to insert index pin 22-J107-4.00 in LH aileron interconnect outboard idler crank. If index pin cannot be inserted, disconnect push-pull rod from outboard arm of idler crank, adjust length of rod to rigged bell crank and idler crank, tighten check nut on rod end, and install rod on idler crank.

(5) Remove index pin from aileron outboard interconnect bell crank and attempt to insert index pin 22-J107-2.50 in aileron interconnect inboard idler crank at mixer. If index pin cannot be inserted, disconnect push-pull rod from inboard idler crank, insert index pin, adjust length of rod to rigged idler cranks, tighten check nut on rod end, and install push-pull rod on inboard idler crank.

(6) Remove index pin from interconnect outboard idler crank.

(7) Attempt to insert index pins 22-J107-4.0 and -3.0 in RH aileron interconnect outboard idler and RH aileron outboard interconnect bell crank. If index pins cannot be inserted, disconnect push-pull rod or rods as appropriate, adjust length of push-pull rods as indicated, tighten check nuts, and re-install push-pull rods.

(8) Remove index pins from LH aileron interconnect inboard idler and RH aileron interconnect outboard idler.

(9) Using straight edge, check that RH aileron is streamlined with wing. If not, disconnect push-pull rod from RH aileron interconnect horn, streamline RH aileron, adjust length of push-pull rod as necessary, tighten check nut, and re-install push-pull rod on aileron interconnect horn.

(10) Remove index pin from RH aileron outboard interconnect bell crank.

F. Adjust Aileron Linkage from Aileron Aft Bell Crank to Aileron Flight Tabs.

(1) Disconnect control rod from each aileron flight tab horn.

(2) Check that index pin 22-J107-2.00 is inserted in aileron aft bell crank in hydraulic compartment and insert index pin 22-J107-4.00 in aileron vertical lever in mixer.

NOTE: Prior to installing control rod in the following step, check bearings in aileron vertical lever two-bearing assembly for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

(3) Adjust control rod to length between rigged aileron aft bell crank and aileron vertical lever, tighten check nut on rod end bearing, and install control rod on aft bell crank and aileron vertical lever.

(4) Disconnect control rods from aileron horizontal bell cranks at sides of mixer and insert index pin 22-J107-4.00 in each bell crank.

NOTE: Prior to installing control rod in the following step, check bearings in horizontal bell crank two-bearing assembly for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

(5) Adjust control rods to distance between lower end of rigged vertical lever and rigged horizontal bell cranks, tighten check nuts on rod end bearings, and reinstall control rods on horizontal bell cranks.

(6) Adjust tension of inboard and outboard pair of control cables in LH wing to 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specfied cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(7) Attempt to insert index pins 22-J107-3.00 through aileron idlers and aileron outboard bell cranks in wing. If index pins cannot be inserted, alternately loosen and tighten opposing cables until index pins can be inserted.

(8) Recheck tension of cables and safety turnbuckles with NAS 651 safety clips.

(9) Rig aileron control cables in RH wing by repeating steps (6) through (8), substituting RH for LH.

(10) Using straight edge, establish streamline position of ailerons with wings and flight tabs with ailerons.

(11) Remove straight edge.

(12) At each aileron hinge line bell crank, disconnect control rod that extends forward to aileron outboard bell crank.

(13) Install tools No. 30-44416-901 and -902 (LH and RH) between stop bar and bolt head on each aileron hinge line bell crank.

(14) Lock aileron flight tabs within 0.5 degree of streamline with ailerons.

(15) Adjust aileron flight tab rods to length between rigged bell cranks and flight tab horns, tighten check nuts on rod end bearings, and install aft end of rods on aileron flight tab horns.

(16) Adjust control rods to distance between rigged hinge line bell cranks and rigged outboard aileron bell cranks, tighten check nuts on rod ends, and install aft end of control rods on aileron hinge line bell cranks.

(17) Adjust length of rods connecting flight tab flutter dampers to flight tab horns to nominal length and reinstall on flight tab horns.

(18) Unlock aileron flight tabs, remove rigging tools from aileron hinge line bell cranks, and remove index pins from all bell cranks and idlers and from aileron vertical lever.

G. Adjust Aileron Gust Dampers.

(1) Install protractors No. 30-18001-1 and -2 on ailerons and adjust to read 0 (±0.5) degree when ailerons are streamline with wings.

(2) Move RH aileron to full "down" position and check that LH aileron moves up 15 (+1.0, -0.5) degrees and that RH aileron moves down 15 (+1.0, -0.5) degrees. Move RH aileron to full "up" position and check that LH and RH ailerons move "down" and "up" respectively 15 (+1.0, -0.5) degrees from streamline.

(3) If aileron travel is not within tolerance, disconnect gust dampers from aileron "A" frames and continue with step (4).

(4) Move LH aileron "up" 15 (+1.0, -0.5) degrees from streamline and lock in this position. The other aileron will move "down" 15 (+1.0, -0.5) degrees.

(5) Extend piston rod until piston bottoms out in damper cylinder.

(6) Adjust piston rod end bearing until bolt will pass through end bearing and "A" frame clevis.

(7) Tighten and safety piston rod lock nut and install piston rod on "A" frame.

(8) Adjust gust damper of RH aileron by repeating steps (4) through (7), substituting RH for LH.

(9) Rotate pilot's control wheel right and left until lowered aileron on each cycle is stopped by its gust damper.

(10) Full down position of lowered aileron shall be 15 (+1.0, -0.5) degrees and up position of raised aileron shall be 15 (+1.0, -0.5) degrees. If not, adjust piston rod end bearings until tolerances are met.

H. Adjust Aileron Flight Tab and Cockpit Stops.

(1) Install check gages No. 30-18001-903 and -904 on LH and RH ailerons to measure flight tab throws.

(2) Deflect ailerons to "full throw" position and lock in place.

(3) Deflect flight tabs 20 (±0.5) degrees in direction opposite to that in which ailerons are deflected and lock in place.

(4) Adjust stop bolt in each aileron hinge line bell crank until bolt touches stop tube. Safety stop bolts.

(5) Release aileron locks, deflect ailerons in opposite direction to full throw position and lock in place.

(6) Release flight tab locks, deflect flight tabs to 20 (±0.5) degrees in opposite direction, and lock in place.

(7) Adjust other stop bolt in each aileron hinge line bell crank until bolt touches stop tube. Safety stop bolts.

(8) Release aileron and aileron flight tab locks and return ailerons and flight tabs to streamline.

(9) Rotate copilot's control wheel CW until stop at spoiler aft bell crank makes contact and check that swinging frame in mixer has rotated 60 (±0.5) degrees from center position. If not, adjust stop in spoiler aft bell crank bracket as necessary by adding or removing washers under head of stop bolt.

NOTE: One AN 960 PD 416L washer is the equivalent of approximately 0.36 degree of swinging frame rotation.

(10) Rotate copilot's control wheel CCW until stop at spoiler aft bell crank makes contact and check that swinging frame in mixer has rotated 60 (±0.5) degrees from center position. If not, adjust stop in spoiler aft bell crank bracket as necessary by adding or removing washers under head of stop bolt.

(11) Deflect and secure ailerons in full "left wing down" position.

(12) Rotate copilot's control wheel CW until stop in spoiler aft bell crank makes contact and adjust cockpit stop at base of copilot's control column as necessary to provide clearance of 0.15 (+0.06, -0.03) inch.

(13) Continue to rotate pilot's control wheel CW until aileron flight tab stops make contact and adjust cockpit stop at base of pilot's control column as necessary to provide clearance of 0.15 (+0.06, -0.03) inch.

NOTE: The spring-loaded interconnect tube will be partially compressed when the pilot's control wheel is rotated far enough to cause the flight tab stops to make contact.

(14) Deflect and secure ailerons in full "right wing down" position.

(15) Rotate copilot's control wheel CCW until stop in spoiler aft bell crank makes contact and adjust cockpit stop at base of copilot's control column as necessary to provide clearance of 0.15 (+0.06, -0.03) inch.

(16) Continue to rotate pilot's control wheel CCW until aileron flight tab stops make contact and adjust cockpit stop at base of pilot's control column as necessary to provide clearance of 0.15 (+0.06, -0.03) inch.

(17) Return ailerons and control wheels to neutral position.

I. Conclusion.

(1) When aileron system rigging has been completed, test aileron control system (refer to Adjustment/Test - Aileron System Functional Test).

2. Adjustment/Test Aileron System Functional Test

A. Equipment Required.

(1) Aileron flight and trim tab check gages No. 30-18001-903 and -904 to measure flight tab and trim tab throws.

(2) Calibrated weights and provisions for attaching weights to aileron trailing edge, test tool No. 30-18001-901 TSTO.

(3) Spring scale calibrated from 0 to 30 pounds with adapter for attaching spring scale to turnbuckles in pilot's and copilot's control columns.

(4) Tool No. 22-04302 for securing copilot's control wheel in neutral position (see Figure 204).

(5) Specially calibrated tensiometer for measuring tension of nonflex control cables.

(6) Thermometer calibrated in degrees F or C.

(7) Stop watch.

(8) Torque wrench calibrated in foot-pounds and an adapter for attaching torque wrench to pilot's control wheel.

(9) Protractors No. 30-18001-1 and -2 to measure aileron surface travel.

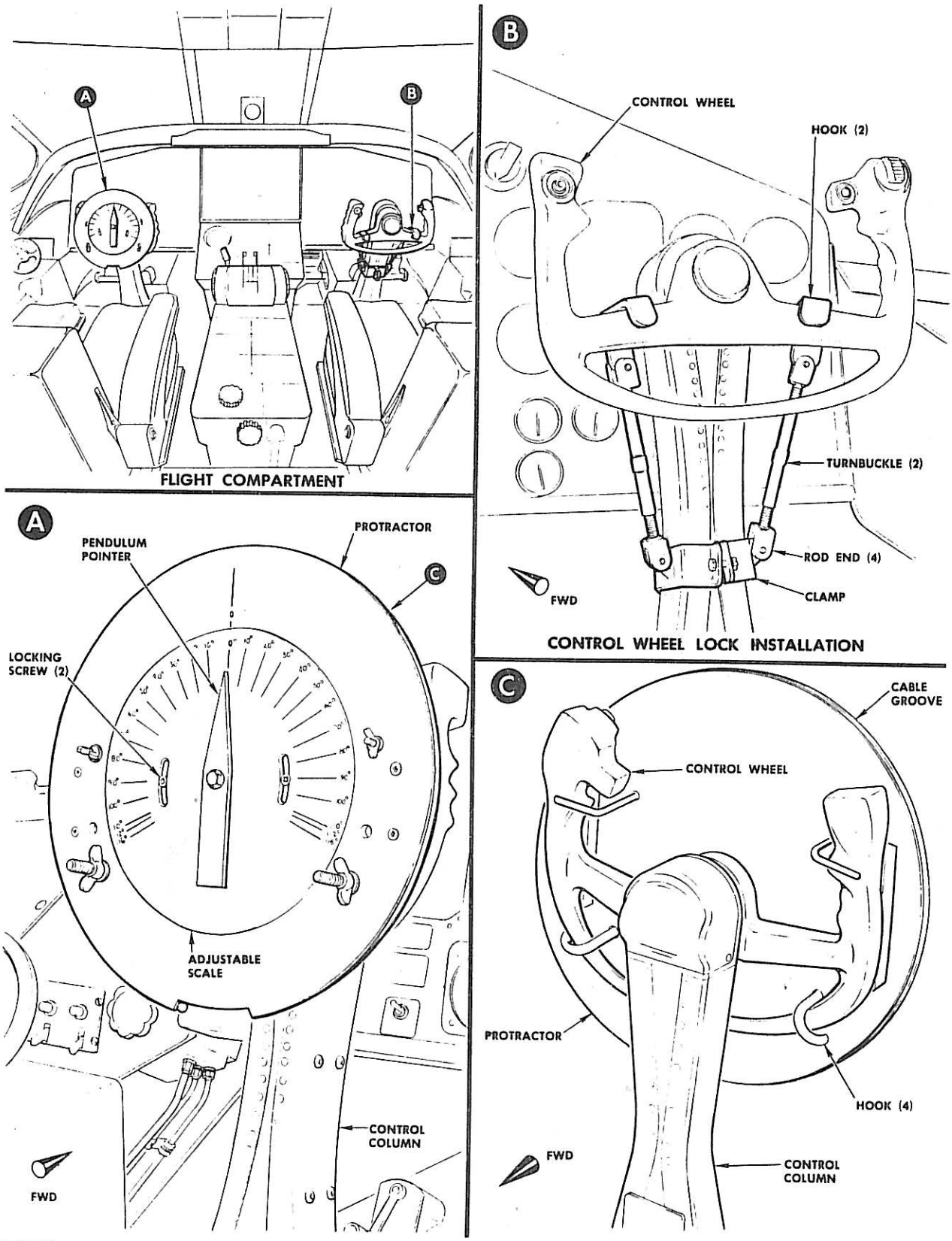
B. Preoperational Check.

NOTE: The spoiler system must be rigged before performing the following aileron functional tests (refer to Adjustment/Test - Adjust Spoiler System).

(1) Open shroud doors in under surface of wing in line with RH and LH ailerons.

(2) Visually inspect aileron and spoiler systems for proper installation of fairleads, pulleys, drums, quadrants, bell cranks, torque tubes, terminals, pressure seals, turnbuckles, cable guards, flutter and gust dampers, etc. Check that all installations are safety wired, where applicable, and that safety clips are in place in all turnbuckles.

(3) Remove access doors from pilot's control column, attach spring scale to turnbuckle, and check that force required to deflect control cable 0.70 (+0.03, -0.35) inch is 25 (±2.0) pounds.


A
B
FLIGHT COMPARTMENT
B
CONTROL WHEEL
HOOK (2)
TURNBUCKLE (2)
ROD END (4)
CLAMP
FWD
CONTROL WHEEL LOCK INSTALLATION
A
PENDULUM POINTER
PROTRACTOR
C
LOCKING SCREW (2)
ADJUSTABLE SCALE
CONTROL COLUMN
FWD
C
CABLE GROOVE
CONTROL WHEEL
PROTRACTOR
HOOK (4)
FWD
CONTROL COLUMN
22.02.27.203
CONTROL WHEEL PROTRACTOR INSTALLATION

(4) Using same procedure, check that tension of control cables in co-pilot's control column is within tolerance.

(5) Using specially calibrated tensiometer, check that tension of non-flex cables in aileron control system is 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(6) Deflect RH and LH ailerons through full travel and check that curtains in balance panel compartments do not tend to bind or stick against interior surfaces of compartments.

(7) Install protractor 30-18001-1 on LH aileron flight tab.

(8) Using straight edge, streamline LH aileron with wing and flight tab with aileron and adjust protractor to read 0°.

(9) Repeat steps (6) and (7) substituting RH for LH and -2 for -1.

(10) Install check gages 30-18001-903 and -904 on LH and RH ailerons. Check gages shall indicate streamline position of aileron flight and trim tabs.

C. Aileron Surface Travel and Friction Checks.

(1) Check that protractor on each aileron is adjusted to read 0° when aileron is streamlined with wing and flight tab is streamlined with aileron.

NOTE: If ailerons are being checked following adjustment of the aileron system, proceed with step (5). If not, continue with step (2).

(2) Maintain RH aileron and flight tab in streamline position and record reading of protractor on LH aileron flight tab. One-half the difference between the indications of the two protractors represents the amount of droop incorporated in the aileron interconnect linkage to maintain the ailerons in the streamlined position during high speed flight. Record droop value.

(3) If indicated droop exceeds 0.125 degree, proceed with step (4); if not, omit step (4) and continue with step (5).

(4) Secure RH aileron and flight tab in streamline position, disconnect aileron interconnect push-pull rod from LH aileron interconnect inboard idler in hydraulic compartment, lengthen rod end as required to streamline LH aileron with wing, and connect push-pull rod to idler temporarily.

(5) Deflect and hold LH aileron 5 degrees above streamline and indicate aileron deflection by a strip of masking tape on inboard rib of outboard flap.

(6) Position and hold LH aileron successively at 5 degrees and 14.5 degrees below streamline and mark deflection with strip of masking tape.

(7) Deflect LH aileron downward until gust damper stop makes contact and check that protractor on LH aileron reads 15 (+1.0, -0.5) degrees "down" and that protractor on RH aileron reads 15(+1.0, -0.5) degrees "up".

(8) Repeat steps (5) through (7) substituting RH for LH and LH for RH.

(9) Remove protractors from LH and RH aileron flight tabs.

(10) Attach 12-pound weight to LH aileron trailing edge.

(11) Manually deflect LH aileron 5 degrees above stremline as indicated by masking tape on flap rib.

(12) Release LH aileron and check that aileron moves smoothly down to at least 5 degrees below streamline as indicated by strip of masking tape.

(13) Remove 12-pound weight from LH aileron and attach 26-pound weight to LH aileron trailing edge.

(14) Manually deflect LH aileron to 5 degrees below streamline position, release aileron, and check that LH aileron moves smoothly down to at least 14.5 degrees below streamline position.

(15) Repeat steps (10) through (14) substituting RH aileron for LH aileron.

(16) Remove masking tape from LH and RH flap ribs.

(17) Move pilot's control wheel full travel CW and CCW and check that flight tab control cables, bell cranks, etc. clear surrounding structure throughout full flight tab and aileron travel.

NOTE: Approximately the last third of pilot's control wheel rotation will result in extension or compression of aileron/spoiler spring-loaded crossover tube.

D. Aileron Drive Interconnect Check.

(1) Return ailerons to streamline.

(2) Rotate pilot's control wheel full CW and check that RH aileron is deflected upward at least 7.5 degrees from streamline.

(3) Rotate pilot's control wheel full CCW and check that LH aileron is deflected upward at least 7.5 degrees from streamline.

(4) Return control wheels and ailerons to neutral.

(5) If aileron interconnect linkage was changed in step C.(4), adjust push-pull rod end at aileron interconnect inboard idler to restore droop but check that final droop is from 1.5 degrees down to 0.5 degree up from streamline with wings (ailerons symmetrical).

E. Aileron/Spoiler Interconnect Checks.

(1) With spoilers in streamline position, install tool No. 22-04302 on copilot's control wheel to secure wheel in neutral.

(2) Attach torque wrench adapter to pilot's control wheel.

(3) Manually deflect and hold ailerons in "right wing down" position.

(4) Using torque wrench, rotate pilot's control wheel CW until aileron flight tab stops make contact and check that force required to begin flight tab movement is from 21 to 31.5 foot-pounds and that force required to contact flight tab stops is from 21.6 to 33.2 foot-pounds. Record actual force required to begin flight tab movement and to contact flight tab stops.

(5) Return pilot's control wheel to neutral position.

(6) Manually deflect and hold ailerons in "left wing down" position.

(7) Using torque wrench, rotate pilot's control wheel CCW until aileron flight tab stops make contact and check that force required to begin flight tab movement is from 21 to 31.5 foot-pounds. Actual force required to begin movement shall not differ more than 5.8 pounds from force required to begin flight tab movement recorded in step (4).

(8) Check that force required to contact flight tab stops is from 21.6 to 33.2 foot-pounds. Actual force required to contact flight tab stops shall not differ more than 5.8 pounds from force required to contact flight tab stops in step (4).

(9) Return pilot's control wheel to neutral, and remove torque wrench adapter from pilot's control wheel and locking tool from copilot's control wheel.

F. Aileron Flight Tab Throw and Pilot's Cockpit Stop Checks.

(1) Check that check gages to measure flight and trim tab deflection are installed on LH and RH aileron.

(2) Manually deflect and hold ailerons in "right wing down" position.

(3) Rotate pilot's control wheel CW until aileron flight tab stops make contact and check that RH flight tab is deflected downward 20 (±0.5) degrees from neutral and that LH flight tab is deflected upward 20 (±0.5) degrees from neutral.

(4) With flight tab stops just making contact, check that gap at pilot's cockpit stops is 0.15 (+0.06, -0.03) inch.

(5) Manually deflect and hold ailerons in "left wing down" position.

(6) Rotate pilot's control wheel CCW until aileron flight tab stops make contact and check that RH flight tab is deflected upward 20 (±0.5) degrees from neutral and that LH flight tab is deflected downward 20 (±0.5) degrees from neutral.

(7) With flight tab stops just making contact, check that gap at pilot's cockpit stops is 0.15 (+0.06, -0.03) inch.

(8) Remove check gages from LH and RH ailerons.

G. Test Aileron Gust Dampers.

(1) Check that all rigging tools have been removed from ailerons, aileron flight tabs, and control wheels.

(2) Push up suddenly on center of left aileron trailing edge. Gust dampers shall resist, but not prevent, aileron movement.

(3) Return ailerons to normal position.

(4) Push down suddenly on center of left aileron trailing edge. Gust dampers shall resist, but not prevent, aileron movement.

(5) Return ailerons to normal position.

H. Conclusion.

(1) When all tests are satisfactory, return airplane to normal configuration.

## AILERONS - MAINTENANCE PRACTICES

1. Removal/Installation - Ailerons (see Figure 201)

A. General.

Removal and installation procedures for the LH and RH aileron are identical.

Prior to aileron installation, check the date of balancing and the number of pounds nose heavy on the aileron nameplate. Any aileron flight tab can be installed without rebalancing the aileron if the flight tab is balanced and it does not weigh more than 21.50 pounds. Any aileron trim tab can be installed without rebalancing the aileron if the trim tab does not weigh more than 8.00 pounds. (Do not include attaching hardware (nuts, bolts, and washers) when weighing tabs.) If the weight of the flight tab or trim tab being installed is not within the applicable weight limitation, the aileron must be rebalanced. (Refer to the Structural Repair Manual for balancing instructions.)

B. Equipment Required.

(1) Aileron sling No. 22-J140 or equivalent.

(2) Hoist for lifting aileron.

(3) Tool No. 30-44416 for centering aileron hinge line bell crank.

(4) Protractors No. 30-18001-1 or -2 (LH or RH) for measuring aileron deflection (see 27-1-0, Figure 203).

(5) Index pins No. 22-J107-2.0, -3.0, and -4.0.

(6) Straightedge at least 4 feet long to streamline aileron with wing and flight tab with aileron.

(7) Check gage No. 30-18001-903 or -904 (LH or RH) to indicate position of aileron tabs.

(8) Graphite grease, Specification MIL-G-7187.

C. Remove Aileron.

(1) Remove screws attaching lower hinge seals to linkage doors, open aileron gust damper, flight tab linkage, and trim tab linkage access doors, and remove three balance panel access panels on under surface of wing in line with aileron being removed. Remove five fairings from under surface of aileron.

(2) Remove screws attaching upper hinge seals to wing structure at outboard and center aileron hinges.

(3) Using straightedge, streamline aileron being removed with wing, and streamline flight tab with aileron. Install pendulum protractor No. 30-18001-1 or -2 (LH or RH) on aileron flight tab.

(4) Deflect aileron as necessary and install index pin 22-J107-3.0 in outboard interconnect bell crank of aileron being removed.

(5) Determine new position of aileron as indicated by pendulum protractor with flight tab streamline with aileron. Any deflection from 0 degrees represents amount of droop incorporated in aileron interconnect linkage to compensate for up-float or down-float during high speed flight.

(6) Record aileron droop determined in step (5) for reference when installing replacement aileron.

(7) Remove pendulum protractor from aileron flight tab.

(8) Deflect aileron to "full down" position and disconnect links connecting flutter damper arms to wing structure at inboard and outboard aileron hinges. Links are accessible from above when aileron is lowered.

(9) Disconnect gust damper piston rod from "A" frame.

(10) Remove bolts connecting gust damper support links to fittings on aileron front spar.

(11) Disconnect aileron interconnect push-pull rod from fitting on front spar of aileron.

(12) Disconnect five bonding jumpers from aileron front spar.

(13) Remove screws attaching balance seal retainers to wing structure in balance panel bays.

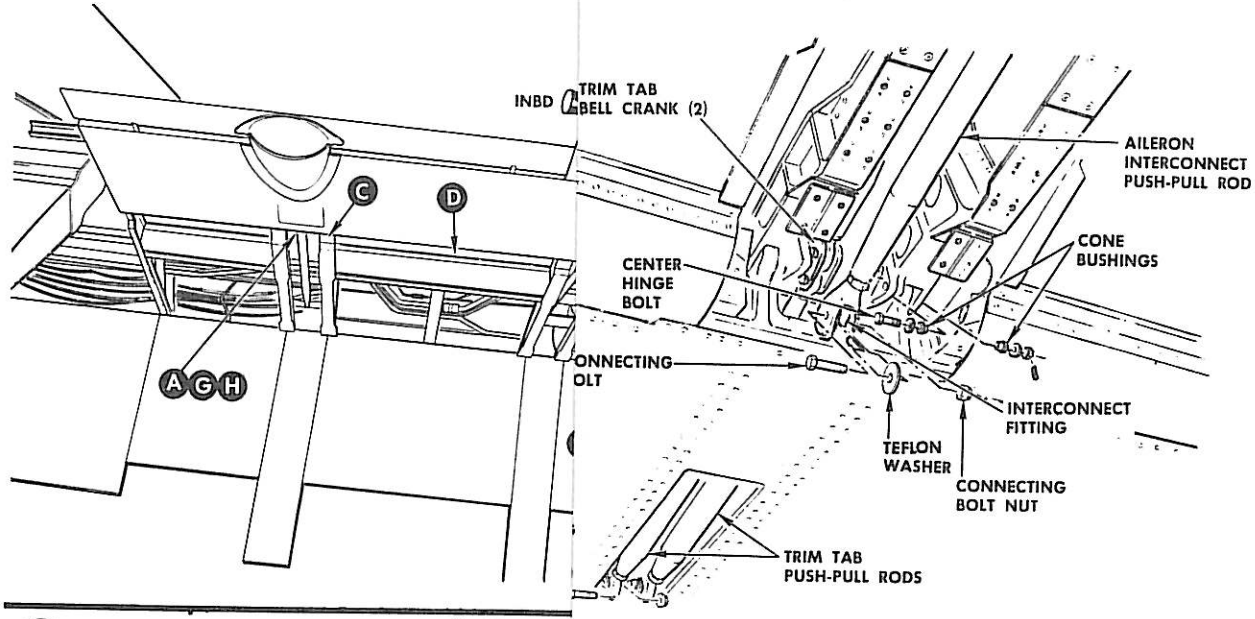
(14) Disconnect aft ends of trim tab push-pull rods from trim tab horns and forward ends of trim jack push-pull rods from trim jack clevises.

(15) Rotate trim tab hinge line bell cranks forward and remove aileron center hinge bolts.

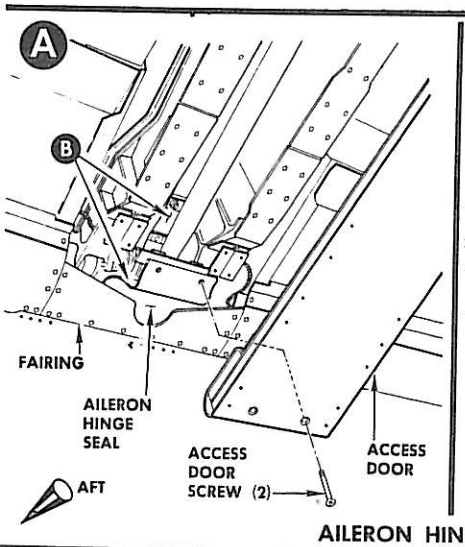
(16) Disconnect fore and aft control rods from flight tab hinge line bell cranks and remove upper stop from bell crank.

(17) Attach sling to aileron and operate hoist to support aileron.

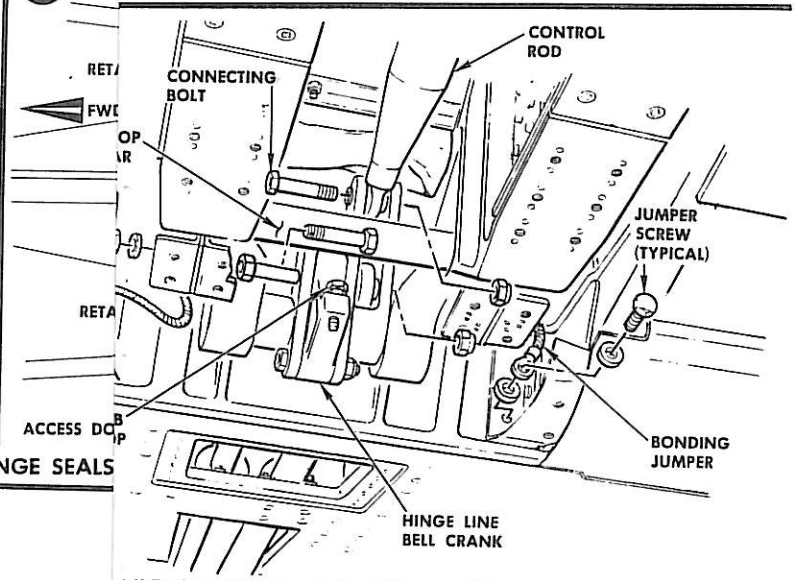
(18) Remove hinge bolts from aileron inboard and outboard hinges. Outboard hinge bolts will clear bell crank when bottom of bell crank is pushed full aft.



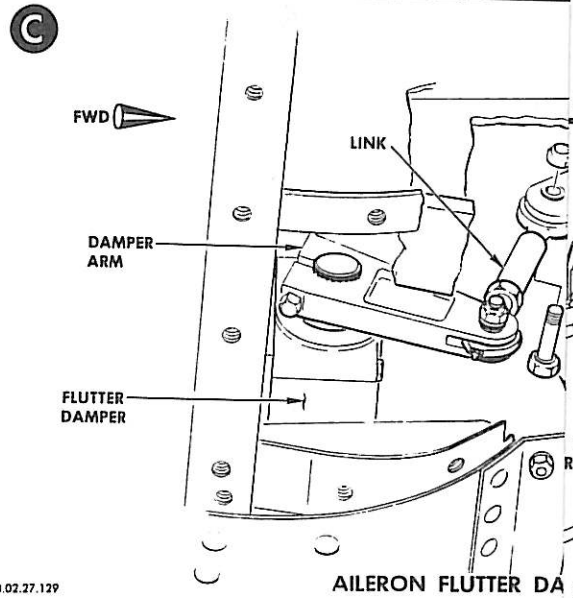

ERON TRIM AND INTERCONNECT RODS

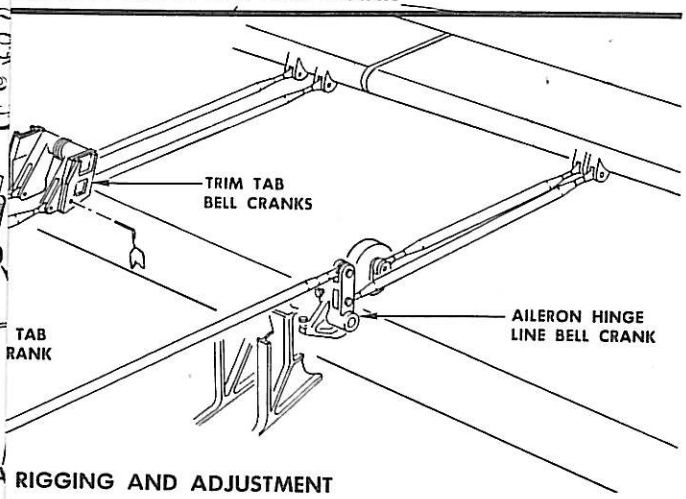



AILERON HINGE SEALS




AILERON HINGE LINE BELL CRANK




AILERON FLUTTER DA RIGGING AND ADJUSTMENT

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(19) Move aileron aft slowly until trim tab push-pull rods clear aileron. Support trim tab push-pull rods to keep them from falling when aileron is clear.

CAUTION: USE EXTREME CARE WHEN REMOVING AILERON TO AVOID DAMAGING TRIM TAB PUSH-PULL RODS OR AILERON.

D. Install Aileron.

(1) Using hoist and sling, raise aileron into position and feed trim tab push-pull rods through opening in aileron.

CAUTION: USE EXTREME CARE WHEN POSITIONING AILERON TO AVOID DAMAGE TO PUSH-PULL RODS AND AILERON.

(2) Install hinge bolts and bushings (refer to Removal/Installation - Split Cone Bushings).

(3) Remove sling from aileron.

(4) Install free ends of bonding jumpers on aileron front spar.

(5) Using straightedge, streamline aileron with wing and flight tab with aileron, install pendulum protractor No. 30-18001-1 or -2 (LH or RH) on aileron flight tab, and adjust to read 0 degrees.

(6) Install check gage No. 30-18001-903 or -904 (LH or RH) on aileron between flight and trim tabs. Contour references on check gage shall indicate streamline position of flight and trim tabs.

(7) Raise aileron until protractor reads 15 (+1.0, -0.5) degrees and secure in this position.

(8) Extend gust damper piston rod until piston bottoms out in cylinder.

(9) Apply a light coat of graphite grease, Specification MIL-G-7187, to outer surface of cone bushings and insert cone bushings in "A" frame fitting. Do not allow graphite grease to come in contact with inside surface of cone bushings.

(10) Adjust length of gust damper piston rod as necessary to align hole in rod end bearing with holes in "A" frame cone bushings and insert connecting bolt.

(11) Move aileron downward until gust damper piston bottoms out and check that protractor on aileron reads 15 (+1.0, -0.5) degrees. If not, adjust length of gust damper piston rod as necessary until aileron travel in both directions is 15 (+1.0, -0.5) degrees.

(12) Using spacer block to support "A" frame fitting, tighten connecting bolt nut and force bushings against gust damper rod end bearing.

(13) Loosen nut, remove spacer block, retighten nut, and safety with cotter pin.

(14) Tighten gust damper piston rod lock nut and safety with locking pin and safety wire.

(15) With index pin 22-J107-3.0 installed in aileron outboard interconnect bell crank, secure aileron in position incorporating droop recorded in step C.(6) and adjust length of aileron interconnect rod to distance between rigged outboard interconnect bell crank and interconnect fitting on aileron leading edge. Tighten interconnect rod lock nut and install aft end of interconnect rod on aileron interconnect fitting. Remove index pin.

(16) Install bolts attaching upper hinge seals to wing trailing edge and aileron leading edge.

(17) Install bolts connecting flutter damper links to link fittings at inboard and outboard hinge points.

(18) Check that trim knob on pilots' pedestal is positioned at 0 degrees and install index pins No. 22-J107-2.0 in trim tab bell cranks.

(19) Adjust length of aileron trim jack push-pull rods as necessary to distance between rigged bell cranks and positioned trim jack clevises, install push-pull rods on trim jack clevises, and tighten check nuts on push-pull rods.

(20) Secure aileron and aileron trim tab in streamline position.

(21) Adjust length of trim tab control rods to distance between rigged trim tab bell cranks and positioned trim tab horns and tighten push-pull rod check nuts. Connect push-pull rods and install bushings at trim tab horns (refer to 27-0, Installation - Split Cone Bushings).

(22) Remove index pins from aileron trim tab bell cranks.

(23) Replace upper stop in flight tab hinge line bell crank.

NOTE: With aileron raised, flight tab upper stop shall just make contact with stop tube when flight tab is lowered 20 (±0.5) degrees from neutral. With aileron lowered, flight tab lower stop shall just make contact with stop tube when flight tab is raised 20 (±0.5) degrees from neutral.

(24) Install tool No. 30-44416-901 on flight tab hinge line bell crank to lock bell crank in neutral position.

(25) Insert index pin 22-J107-4.0 in flight tab bell crank, adjust control rod to length between rigged flight tab and hinge line bell cranks, install aft end of control rod on hinge line bell crank, and tighten check nut on rod end.

(26) Secure flight tab in neutral position, adjust length of control rod as necessary to distance between rigged hinge line bell crank and positioned flight tab horn, install forward end of control rod on hinge line bell crank, and tighten check nut on control rod.

(27) Remove rigging tool from flight tab hinge line bell crank, close access doors, and replace aileron fairings.

(28) Install bolts attaching lower hinge seals to aileron linkage access doors.

(29) Test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

NOTE: If an aileron only has been replaced and no other rigging or adjustment has been changed, check aileron and aileron flight tab operation and travel per 27-1-0, paragraph 2.C. and steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5), 2.F.(6), 2.D.(5) and paragraph 2.G. in sequence listed.

(30) Check aileron trim system operation (refer to 27-2-0, Adjustment/Test Aileron Trim System Functional Test).

NOTE: If an aileron only has been replaced and no other rigging or adjustment has been changed, check aileron trim system operation per 27-2-0, paragraphs 2.D. and 2.E.

## AILERON FLIGHT TABS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Flight Tabs (see Figure 201)

A. General.

Removal and installation procedures for LH and RH aileron flight tabs are identical except for being LH and RH assemblies. Prior to flight tab installation, it must be determined that flight tab is balanced. Date of balancing, number of pounds nose heavy, and total weight of tab are stamped on tab nameplate. Flight tab installation will not affect aileron balance if total weight of tab does not exceed 21.50 pounds. (Do not include attaching hardware (nuts, bolts, and washers) when weighing flight tab.) If flight tab weight exceeds specified limit, the aileron must be rebalanced (refer to the 990 Structural Repair Manual).

B. Equipment Required.

(1) Straightedge at least four feet long for streamlining aileron with wing.

(2) Check gage No. 30-18001-903 or -904 (LH or RH) to indicate position of aileron tabs.

(3) Index pin No. 22-J107-4.0.

(4) Graphite grease, Specification MIL-G-7187.

C. Remove Aileron Flight Tab.

(1) Remove screws and open flight tab linkage access door. Lower end of lower hinge seal will come free when the two aft center screws are removed.

(2) Remove flight tab bell crank fairing and flight tab horn fairing from under surface of aileron, and hinge fairings from under surface of flight tab.

(3) Remove bolts connecting flight tab control rod and flutter damper push-pull rod to flight tab horn.

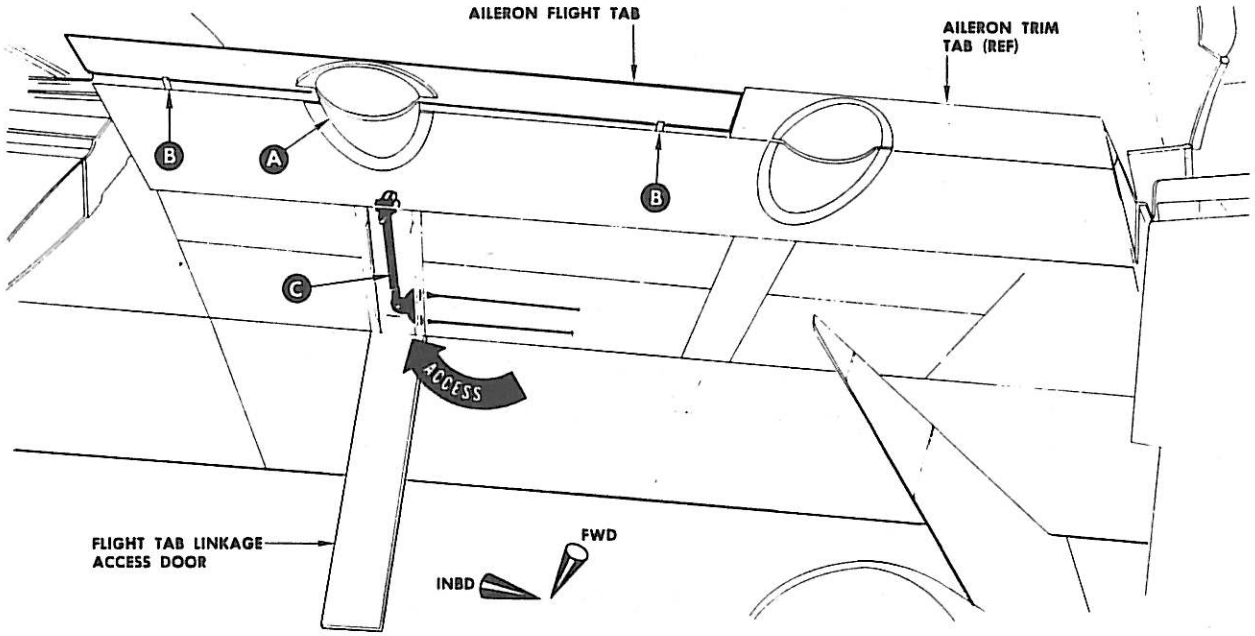
(4) Remove flight tab hinge bolts.

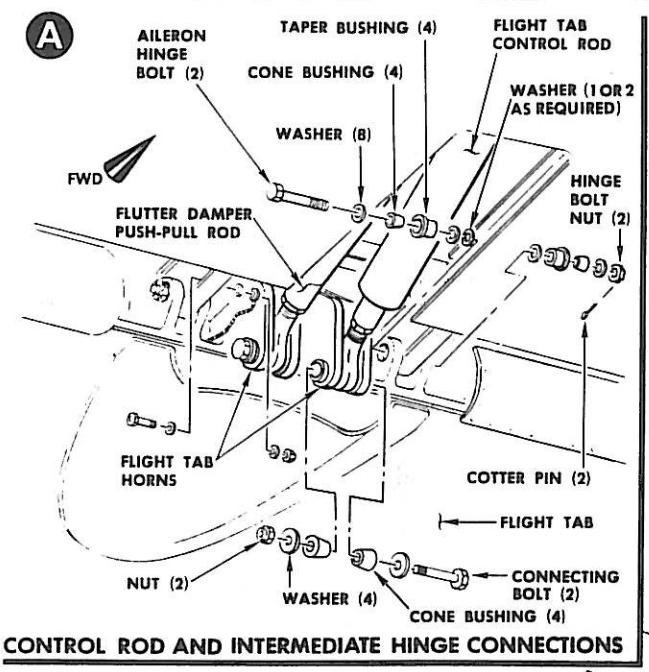
(5) Slide flight tab aft and disconnect bonding jumpers from flight tab hinge fittings.

D. Install Aileron Flight Tab.

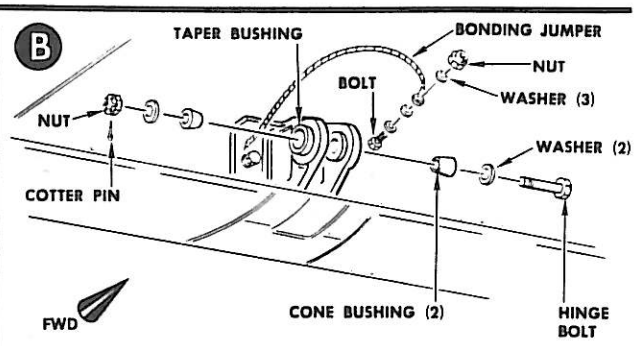
(1) Position flight tab and connect free ends of bonding jumpers.

(2) Install hinge bolts and bushings (refer to 27-0, Installation Split Cone Bushings).

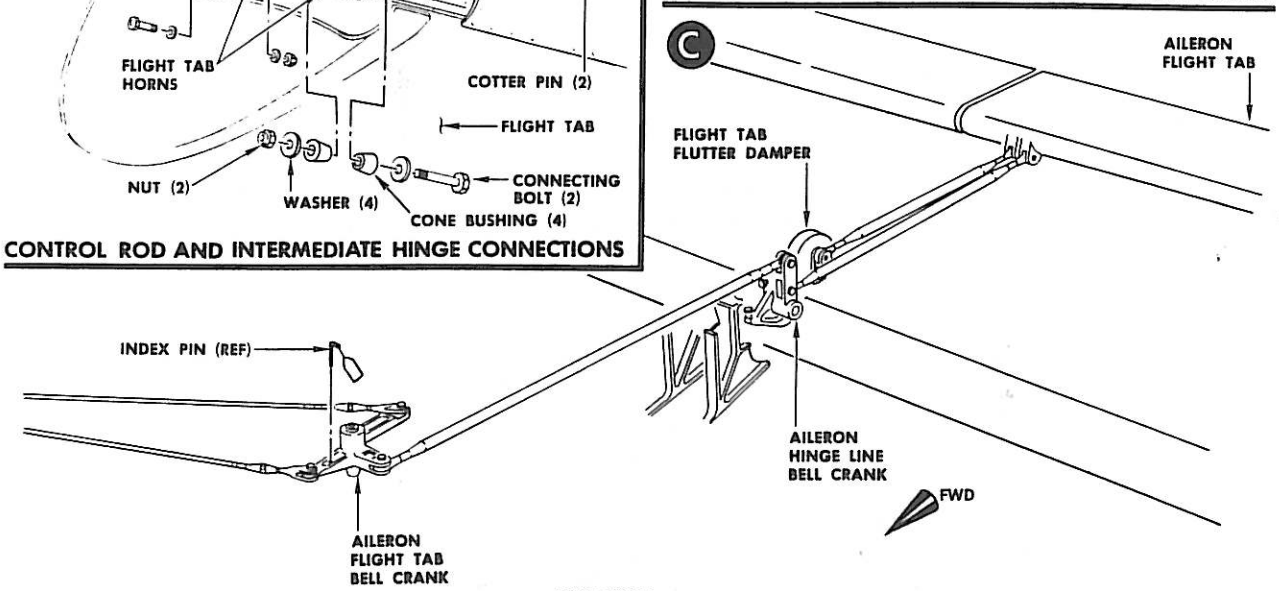



CONTROL ROD AND INTERMEDIATE HINGE CONNECTIONS




TYPICAL INBOARD AND OUTBOARD HINGE CONNECTIONS




RIGGING

30.02.27.130 A

(3) Install check gage No. 30-18001-903 or -904 (LH or RH) on aileron between flight and trim tabs and using straightedge, streamline aileron with wing and flight tab with aileron.

(4) Insert index pin No. 22-J107-4.0 in aileron flight tab bell crank.

(5) Adjust length of flight tab control rod as necessary to align hole in aft end of flight tab control rod with holes in flight tab horn, and tighten check nut. Install control rod and cone bushings (refer to 27-0, Installation Split Cone Bushings).

(6) Install flutter damper push-pull rod and bushings at flight tab horn (refer to 27-0, Installation Cone Bushings).

(7) Remove index pin from aileron flight tab bell crank.

(8) Close linkage access door and attach free end of flight tab lower hinge seal.

(9) Test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

NOTE: If a flight tab only has been replaced and no other rigging or adjustment has been changed, check flight tab operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5), and 2.F.(6).

## AILERON SEALS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Seals

A. General.

Hinge seals are installed at the center and outboard pair of aileron hinges. Attachment at both locations is typical. Balance seals are installed on leading edge of aileron in the three balance bays. Attachment at the three locations is similar except that the retainer attaching the seal to the aileron at the outboard end of center bay and the inboard end of the inboard bay is installed with the beaded edge down. At other locations, the retainers are installed with the beaded edge up.

B. Equipment Required. None.

C. Remove Aileron Hinge Seals (see Figure 201).

(1) If removing upper hinge seal, lower aileron and remove two screws attaching forward end of seal to wing trailing edge and two screws attaching aft end of seal to upper surface of aileron. Tag seal retainers for installation.

(2) If removing lower hinge seal, raise aileron and remove two screws attaching forward end of seal to aileron linkage door in under surface of wing and six screws attaching aft end of seal to hinge fairing. Seal retainers are not interchangeable.

D. Install Aileron Hinge Seals.

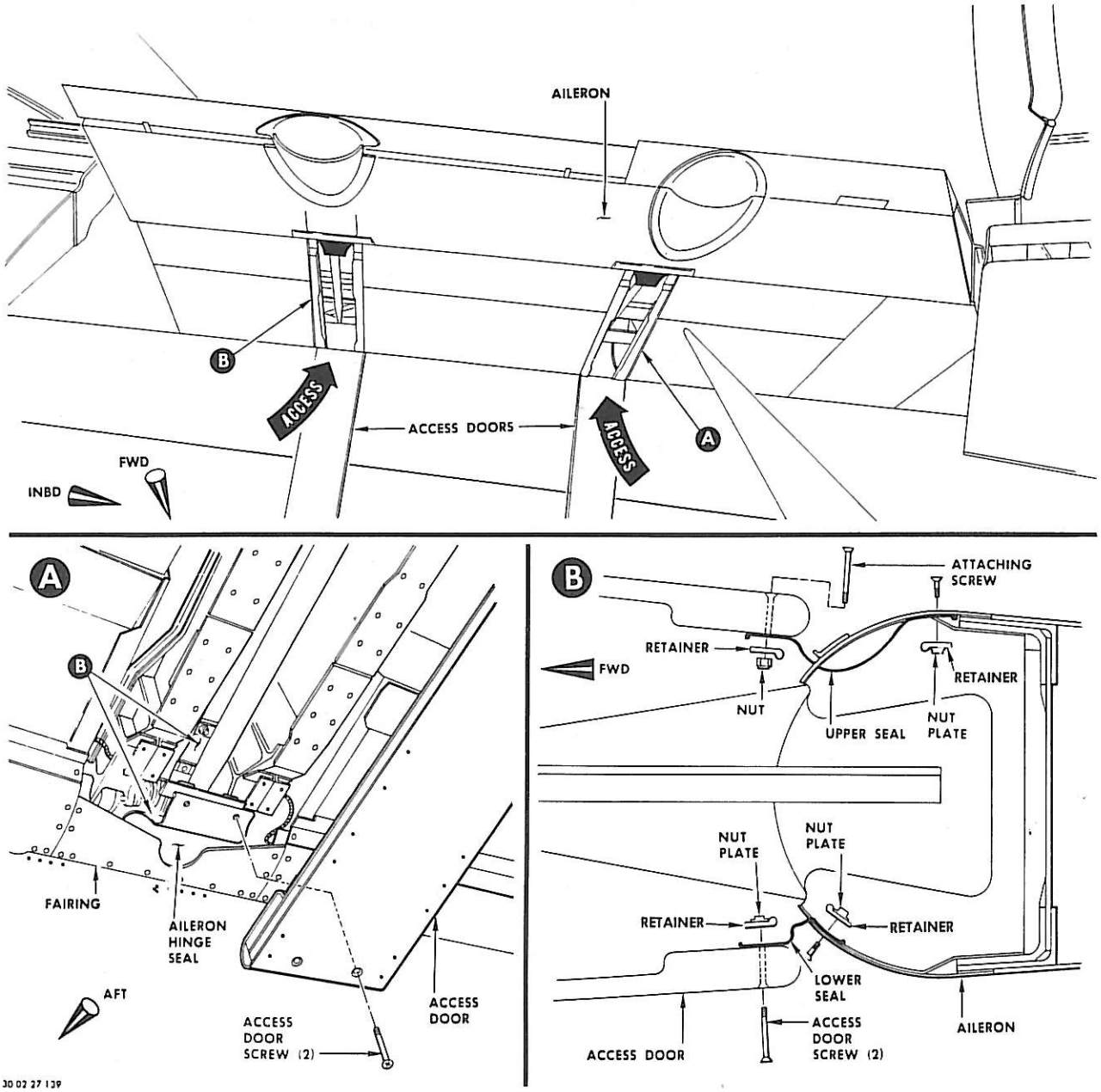
(1) Check that new seal has the same dash number as that of the seal removed.

(2) Using seal removed as a pattern, mark location of holes for retainer screws with ball point pen and punch holes in new seal.

(3) Position each end of seal and retainer and install retainer screws. Nut plates are installed at all attachment points.

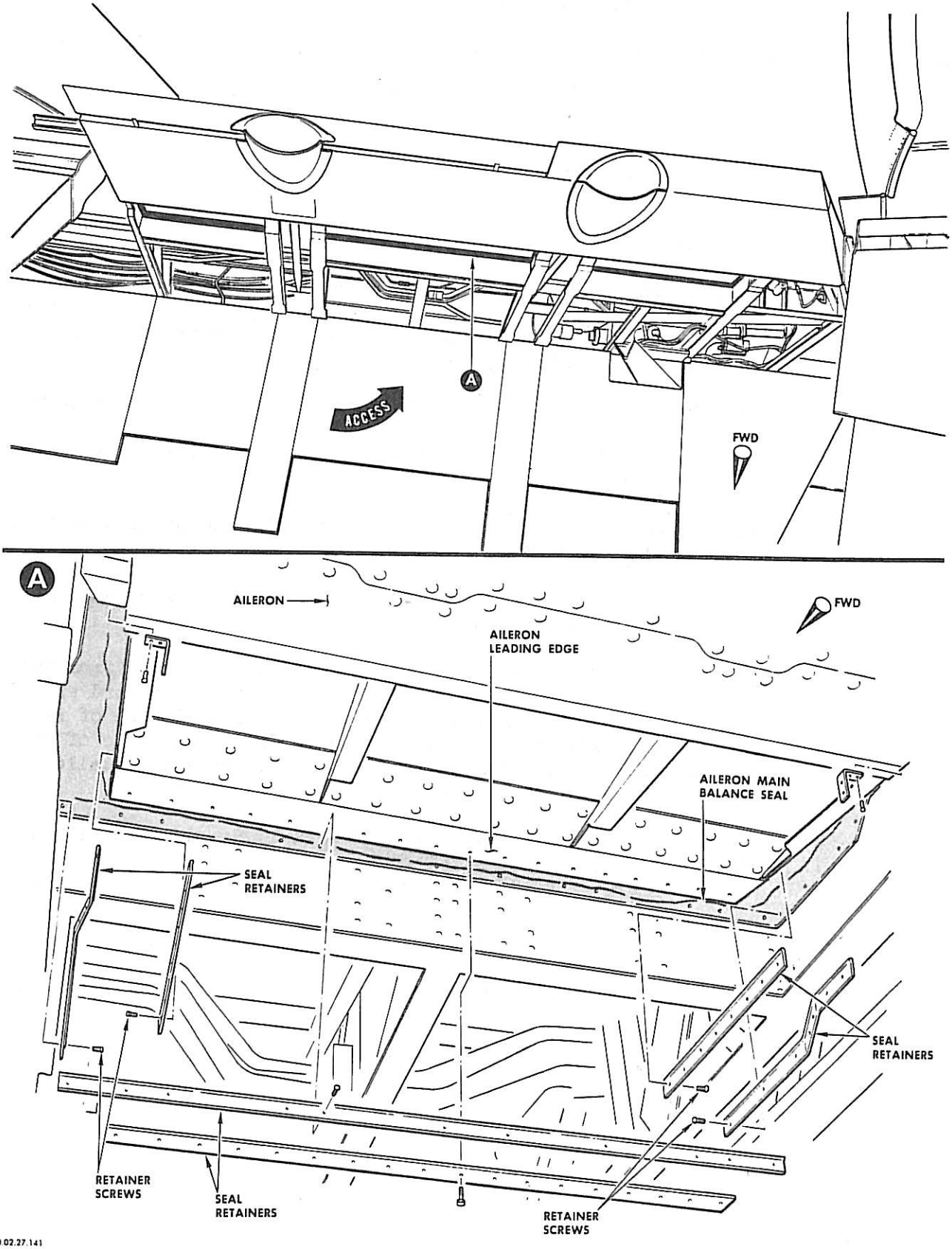
(4) Check aileron operation (refer to 27-1-0, Adjustment/Test Aileron System Functional Test).

NOTE: If an aileron hinge seal only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.C.(1) through 2.C.(4), 2.C.(7), 2.C.(8) and 2.D.(5). In step 2.C.(8), repeat only step 2.C.(7).






Aileron Hinge Seal Installation
Figure 201


A
ACCESS
FWD
A
AILERON
FWD
AILERON
LEADING EDGE
AILERON MAIN
BALANCE SEAL
SEAL
RETAINERS
SEAL
RETAINERS
RETAINER
SCREWS
SEAL
RETAINERS
RETAINER
SCREWS
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E. Remove Aileron Balance Seal (see Figure 202).

(1) Remove aileron (refer to 27-1-1, Removal/Installation - Ailerons).

(2) Remove screws attaching seal to edges of aileron forward extension. Tag seal retainers for installation.

(3) Remove bolts attaching bottom balance weight to leading edge of aileron and remove seal.

F. Install Aileron Balance Seal.

(1) Check that new seal has same dash number as that of seal removed.

(2) Using seal removed as pattern, mark location of screw and bolt holes in new seal with ball point pen.

(3) Punch holes in new seal for retainer screws and balance weight bolts.

(4) Position seal and balance weight beneath leading edge of aileron and install attaching bolts.

(5) Position edge of seal and retainer along each side of aileron forward extension and install retaining screws.

(6) Except at outboard end of outboard bay, position forward end of seal and short retainer and install two screws.

NOTE: All retainers are installed with beaded edge away from edge of seal. At outboard edge of center bay and inboard end of inboard bay, seal is tucked under with beaded edge of retainer downward and seal protruding from lower edge of retainer. At all other locations, retainers are installed with beaded edge upward.

(7) Install aileron on airplane (refer to 27-1-1, Removal/Installation - Ailerons).

## AILERON GUST DAMPERS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Gust Dampers (see Figure 201)

A. Equipment Required.

(1) Straight edge at least four feet long for streamlining aileron with wing.

(2) Protractor No. 30-18001-1 or -2 (LH or RH) for measuring aileron deflection (see 27-1-0, Figure 203).

B. Remove Aileron Gust Damper.

(1) Remove screws and open gust damper door in under surface of wing and remove inboard fairing on forward lower surface of aileron.

(2) Remove bolt connecting damper piston rod end bearing to "A" frame mounted on aileron front spar.

(3) Remove 12 bolts connecting forward end of inboard damper support link to structure and hinge bolt connecting link to fitting on aileron front spar.

(4) Remove gust damper link.

(5) Remove gust damper.

C. Install Aileron Gust Damper.

(1) Insert outboard damper trunion into bearing block of outboard support link.

(2) Position bearing block of inboard support link on inboard trunnion of gust damper.

(3) Install 12 bolts attaching inboard support link to structure.

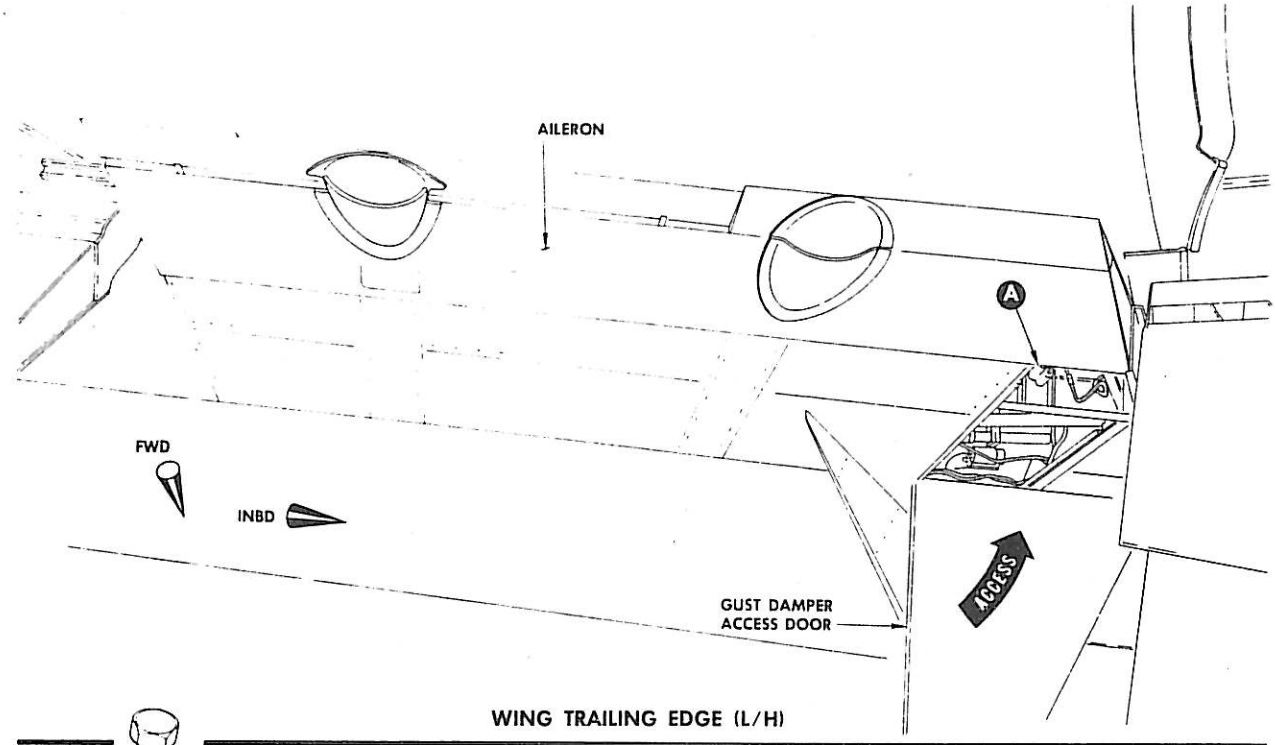
(4) Apply light coat of graphite grease, Specification MIL-G-7187, to outside surface of cone bushings and insert in support link bearings. Do not allow grease to come in contact with inside of cone bushings.

(5) Install hinge bolt in cone bushings and aileron bearing but do not tighten nut.

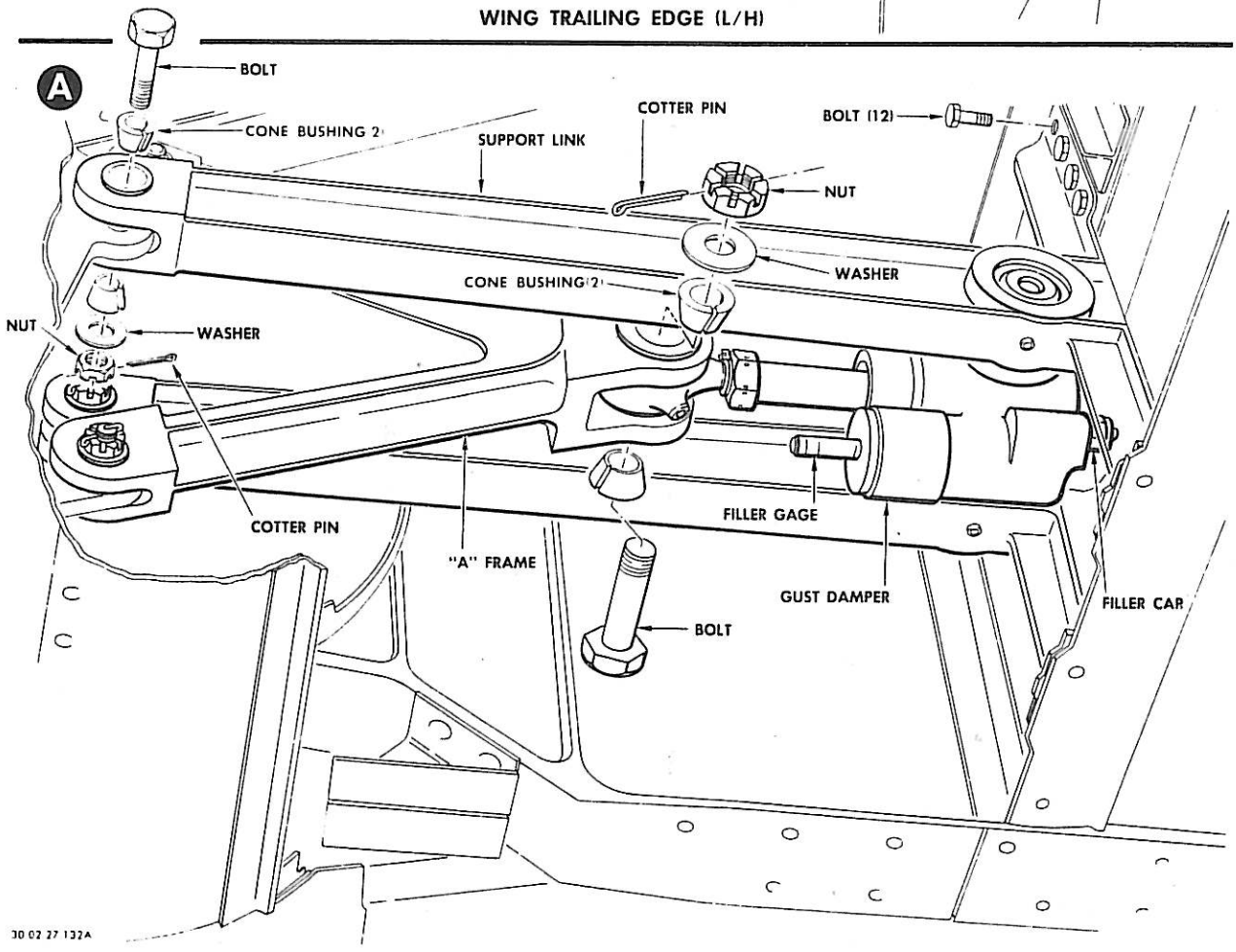
(6) Check that gaps between cone bushings and aileron bearing do not exceed 0.005 inch.

(7) Using spacer block to support link lugs, tighten hinge bolt nut and draw cone bushings against aileron bearing.

(8) Loosen nut, remove spacer block, and tighten nut and secure with cotter pin.




WING TRAILING EDGE (L/H)






Aileron Gust Damper Installation
Figure 201

(9) Disconnect aileron interconnect push-pull rod from fitting on leading edge of aileron.

NOTE: Take care not to turn fitting on push-pull rod end. Rod end must be in same position when reconnecting to aileron so as not to change amount of aileron droop.

(10) Using straightedge, streamline aileron with wing, install protractor No. 30-18001-1 or -2 (LH or RH) on trailing edge of aileron flight tab, and adjust protractor to read 0 degrees.

(11) Apply light coat of graphite grease, Specification MIL-G-7187, on outside surface of cone bushings and insert cone bushings in "A" frame fitting. Do not allow grease to come in contact with inside surface of cone bushings.

(12) Raise aileron until protractor reads 15 degrees and secure in this position.

(13) Extend gust damper piston rod until piston bottoms out in gust damper cylinder and adjust length of piston rod end until bolt will pass through cone bushings and piston rod end bearing.

(14) Lower aileron until gust damper piston bottoms out and check that protractor on aileron reads 15 (+1.0, -0.5) degrees. If not adjust length of piston rod until both up and down aileron travel is limited to 15 (+1.0, -0.5) degrees.

(15) Check that gaps between cone bushings in "A" frame and piston rod end bearing do not exceed 0.005 inch.

(16) Using spacer block to support "A" frame fitting, tighten nut on connecting bolt and draw cone bushings against rod end bearings.

(17) Loosen nut, remove spacer block, and tighten nut and secure with cotter pin.

(18) Tighten check nut on piston rod end and secure with locking key and safety wire.

(19) Return aileron to near streamline position and install bolt connecting interconnect push-pull rod to interconnect fitting on aileron.

(20) Using straightedge, streamline opposite aileron with wing, install protractor No. 30-18001-1 or 2 (LH or RH) on trailing edge of aileron flight tab, and adjust protractor to read 0 degrees.

(21) Test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

NOTE: If a gust damper only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.C.(1) through 2.C.(16) and paragraph 2.G.

2. Adjustment/Test Unit Servicing (see Figure 201)

A. Equipment Required.

(1) Stand suitable to gain access to bottom of ailerons.

(2) Pressure pot with a capacity of one gallon (minimum). Pressure pot to incorporate following:

(a) 1/4-inch fluid port at bottom of pot.

(b) Fitting to connect source of air pressure to pot.

(c) Ten feet of 1/4-inch hose to connect pressure pot to damper, (hose to incorporate shutoff valve in vicinity of damper connection).

(d) Pressure gage graduated from 0 to 100 psig.

(3) Source of 50 psig dry filtered air or nitrogen, to pressurize pot.

(4) Hydraulic fluid, Specification MIL-H-5606, filtered to 10 microns.

B. Procedure.

(1) Add hydraulic fluid, and pressurize pot to 50 psig.

(2) Remove screws and open GUST DAMPER access door located on wing trailing edge.

(3) Remove cap from gust damper filler valve.

(4) Open pressure pot control valve slightly, allowing a few drops of fluid to run from end of hose.

(5) With hose filled with fluid, connect hose to damper filler valve finger tight.

NOTE: Hose is connected to damper only finger tight in order to allow air remaining in hose to escape when control valve is opened.

(6) Open control valve slightly until fluid drips from loose connection at damper.

(7) Tighten hose fitting at damper.

(8) Open control valve and observe damper reservoir fluid volume indicator.

(9) When fluid volume indicator registers FULL, close control valve and disconnect hose from damper.

(10) Install filler valve cap and safety.

(11) Loosen damper bleed plug slightly. When fluid seeps out, tighten bleed plug and safety.

(12) Wipe any spilled hydraulic fluid from airplane structure and secure damper access door.

## AILERON AND SPOILER FORWARD BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron or Spoiler Forward Bell Crank (see Figure 201)

A. Equipment Required.

(1) Two index pins 22-J107-2.0 and two index pins No. 22-J107-2.50 or equivalent.

(2) Specially calibrated cable tensiometer suitable for checking tension of 1/8-inch nonflex cable.

B. Remove Forward Bell Crank.

(1) Open LH or RH tunnel access door in nose of fuselage

(2) Disconnect push-pull rod from upper arm of bell crank.

(3) Loosen one control cable turnbuckle at bell crank.

(4) Disconnect cable from each end of bell crank arm.

(5) Remove bolts from bell crank upper and lower mounting pads and remove bell crank with shaft and upper pad.

(6) Remove shaft from pad and bell crank.

C. Install Forward Bell Crank.

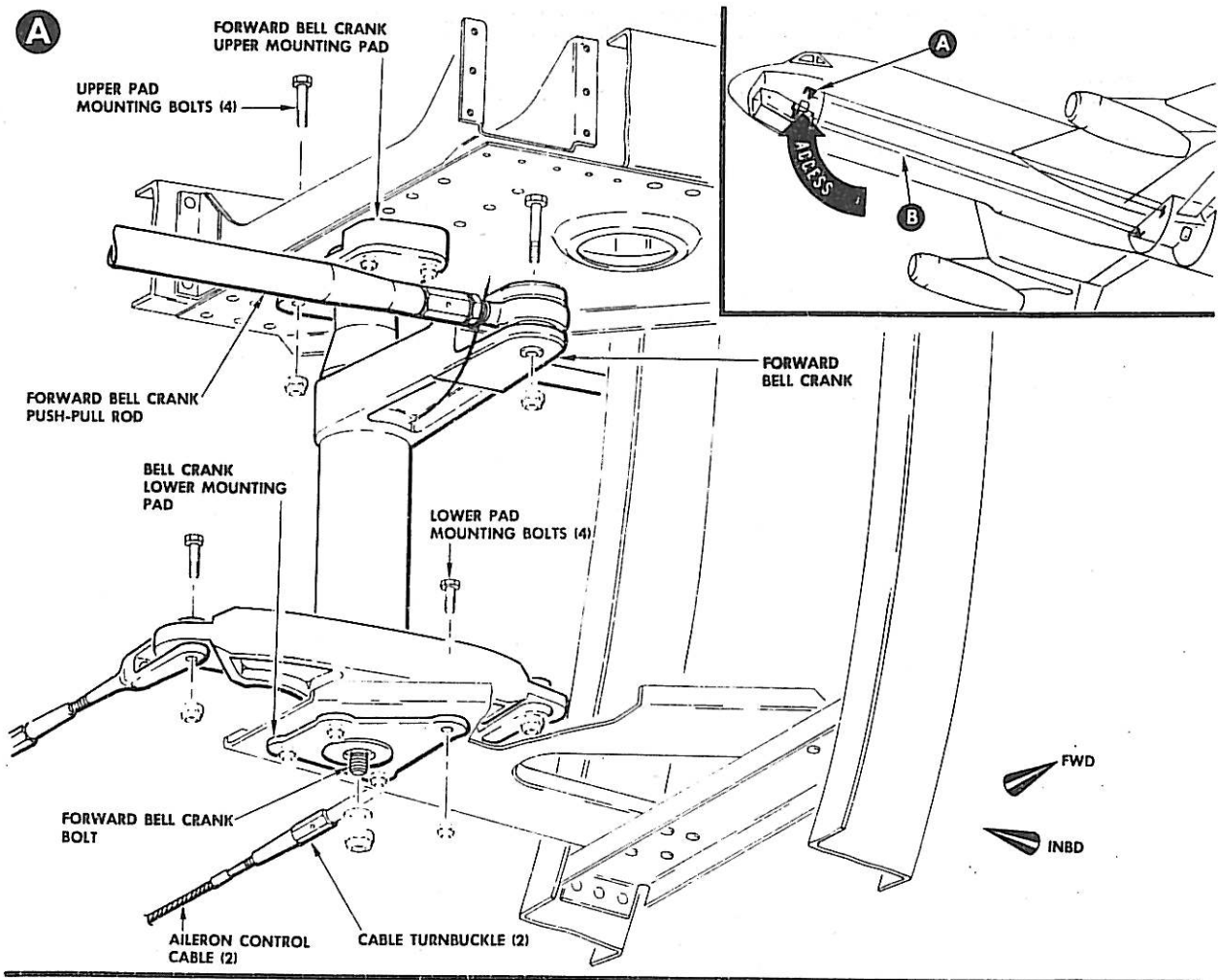
(1) Position bell crank with shaft installed through bell crank and upper mounting pad and install pad mounting bolts in upper and lower pads.

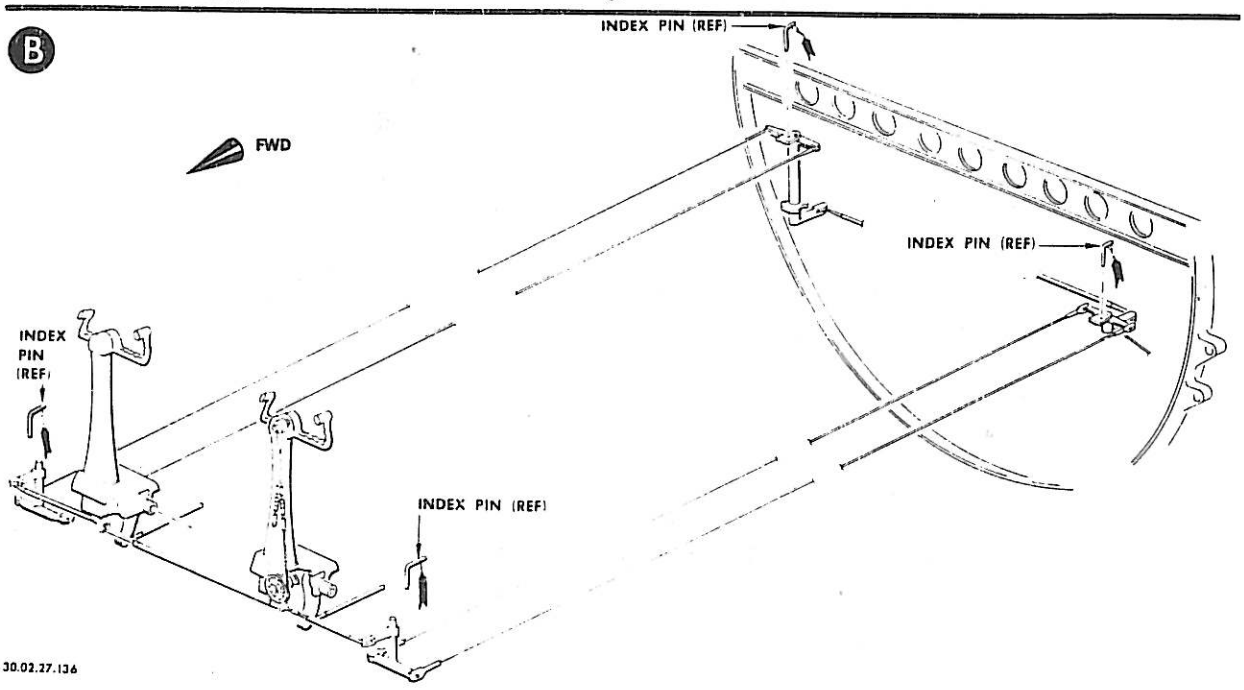
(2) Insert index pins 22-J107-2.5 in aileron and spoiler forward bell cranks.

(3) Adjust push-pull rod disconnected from bell crank being installed to length and install free end on arm at top of bell crank.

(4) Connect control cables to bell crank arms and tighten loosened cable to tension of 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each Degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(5) Attempt to insert index pin No. 22-J107-2.0 in bell crank at aft end of cables just tightened. If index pin cannot be inserted, alternately loosen and tighten opposing cables to align index pin holes in aft bell crank and bracket.




Aileron and Spoiler Forward Bell Cranks Installation
Figure 201

(6) Recheck cable tension, adjust if indicated, and safety turnbuckles with NAS 651.

(7) Remove index pins and test aileron system (refer to 27-1-0 Adjustment/Test - Adjust Aileron System).

NOTE: If an aileron or spoiler forward bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5) and 2.F.(6). Check that bell crank does not bind or stick when control wheel is operated through full travel.

## AILERON AND SPOILER AFT BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron or Spoiler Aft Bell Crank (see Figure 201)

A. Equipment Required.

(1) Index pins No. 22-J107-2.0, -2.5, and -4.0, or equivalent.

(2) Specially calibrated cable tensiometer for checking tension of 1/8-inch nonflex cable.

B. Remove Aft Bell Crank.

(1) Open LH or RH tunnel access door in nose of fuselage.

(2) Loosen one turnbuckle on respective control cable at forward spoiler or aileron bell crank.

(3) Remove cabin floor panel above bell crank being removed (refer to Chapter 53, FUSELAGE, for removal procedure).

(4) Open hydraulic compartment access door below wing trailing edge on LH side of fuselage.

(5) Disconnect control cables from each arm of bell crank being removed.

(6) If aileron aft bell crank is being removed, disconnect control rod connecting bell crank to vertical arm in mixer. If spoiler aft bell crank assembly is being removed, disconnect control rod connecting bell crank to swinging frame in mixer and loosen and disconnect autopilot cables from quadrant on bell crank.

(7) Remove bell crank mounting bolt and remove bell crank.

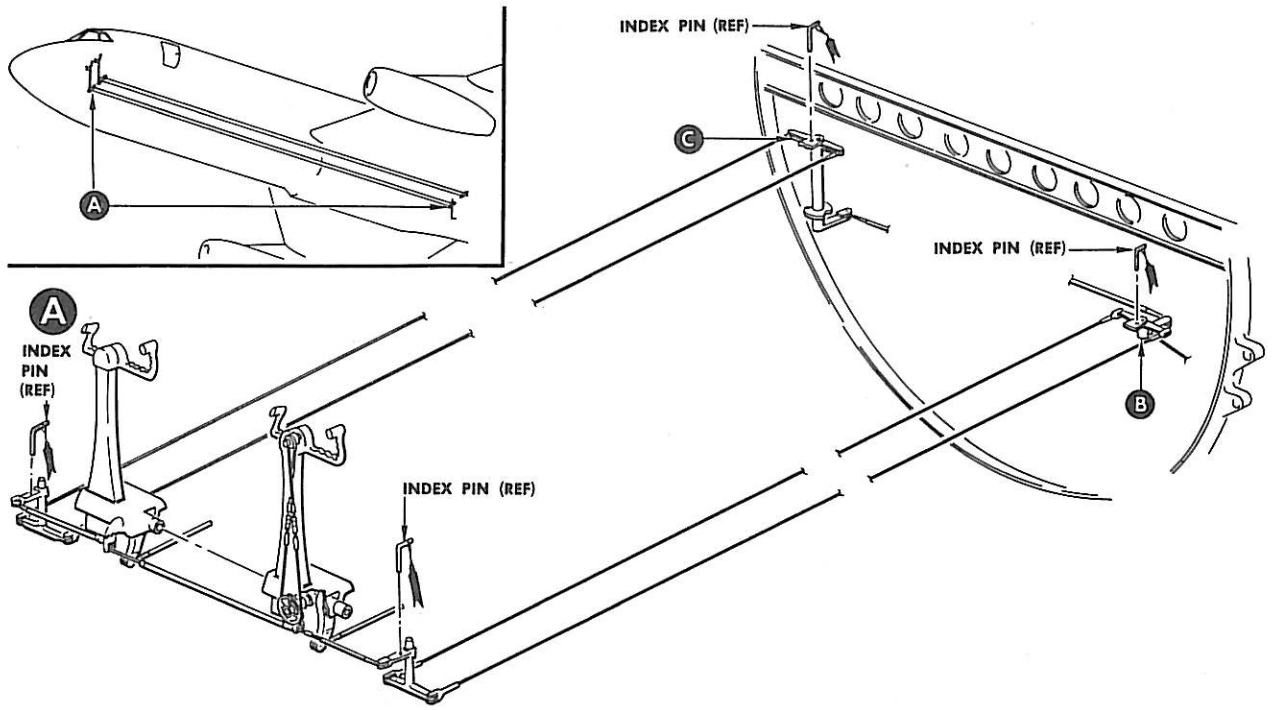
C. Install Aft Bell Crank.

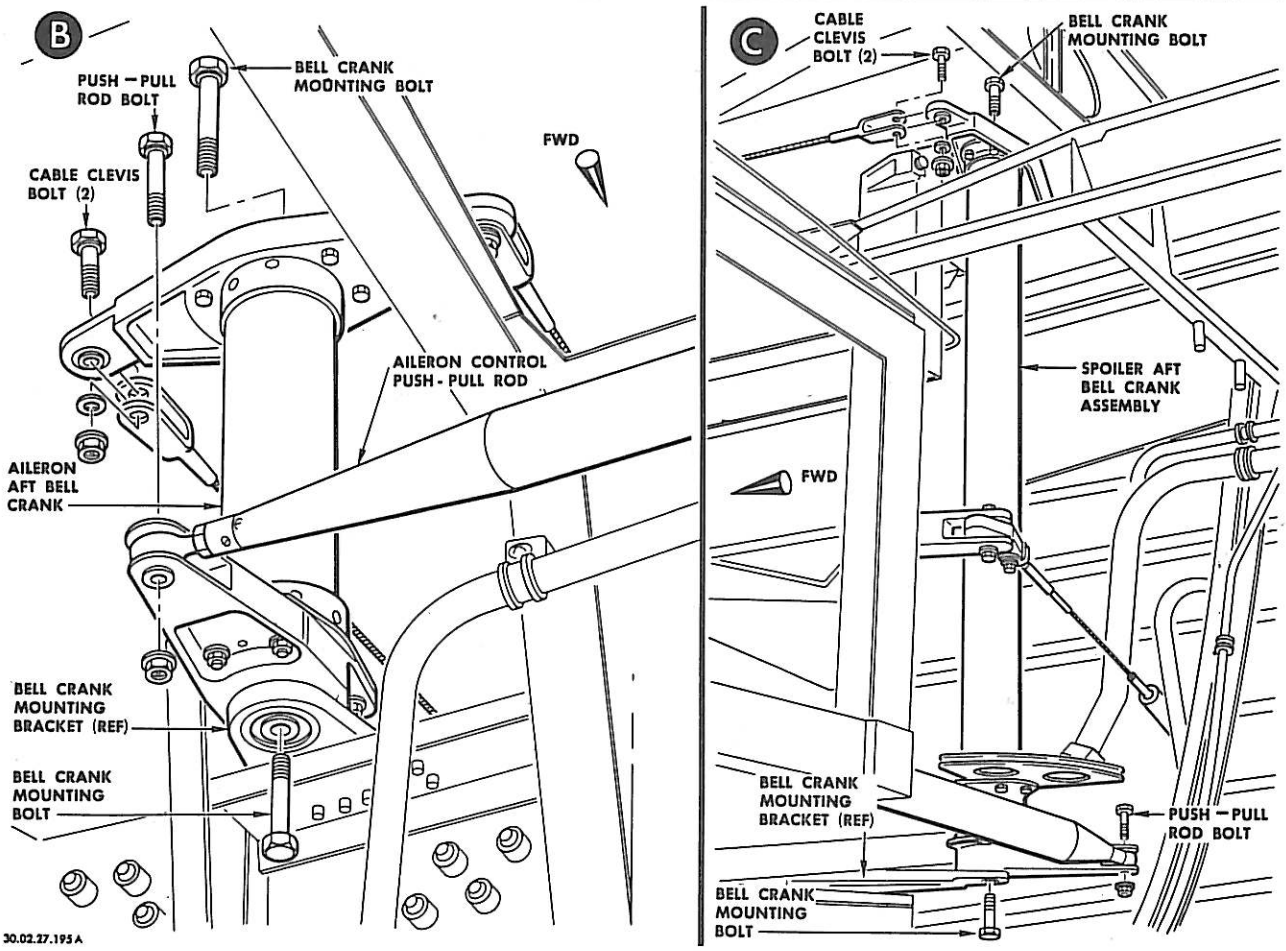
(1) Position bell crank and install mounting bolt.

(2) Insert index pin 22-J107-2.0 in bell crank being installed.

(3) Connect control cables to bell crank and tighten loosened cable to tension of 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

(4) Attempt to insert index pin 22-J107-2.5 in bell crank to which forward ends of cables are attached. If index pin cannot be inserted, alternately loosen and tighten opposing cables to align index pin holes in forward bell crank and bracket.


A
INDEX PIN (REF)
C
INDEX PIN (REF)
B
INDEX PIN (REF)
INDEX PIN (REF)


B
PUSH — PULL ROD BOLT
BELL CRANK MOUNTING BOLT
FWD
CABLE CLEVIS BOLT (2)
AILERON CONTROL PUSH - PULL ROD
AILERON AFT BELL CRANK
BELL CRANK MOUNTING BRACKET (REF)
BELL CRANK MOUNTING BOLT
30.02.27.195 A
C
CABLE CLEVIS BOLT (2)
BELL CRANK MOUNTING BOLT
SPOILER AFT BELL CRANK ASSEMBLY
FWD
BELL CRANK MOUNTING BRACKET (REF)
PUSH — PULL ROD BOLT
BELL CRANK MOUNTING BOLT

(5) Recheck cable tension, adjust if necessary, and safety turnbuckles with NAS 651 clips.

(6) If installing aileron aft bell crank, install index pin 22-J107-4.0 in aileron vertical lever in mixer, adjust control rod to distance between aileron aft bell crank and aileron vertical lever, tighten check nut on rod end, and install outboard end on aileron aft bell crank.

(7) Check aileron control system operation (refer to 27-1-0, Adjustment/ Test Aileron System Functional Test).

NOTE: If an aileron control aft bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5), and 2.F.(6). Check that bell crank does not bind or stick when control wheel is operated through full travel.

(8) If installing spoiler aft bell crank assembly, install index pin 22-J107-4.0 through spoiler housing in mixer, adjust length of control rod to distance between rigged spoiler aft bell crank and swinging frame, tighten check nut on rod end, and install outboard end of control rod on spoiler aft bell crank. Install and adjust autopilot cables on spoiler aft bell crank quadrant (refer to 27-3-0, paragraph 1.H.).

(9) If installing spoiler aft bell crank, rotate copilot's control wheel CW until stop in spoiler aft bell crank bracket makes contact and check that swinging frame in mixer has rotated 60 (±0.5) degrees. If not, adjust stop in spoiler aft bell crank bracket as necessary by removing or adding washers under head of stop bolt. Rotate copilot's control wheel CCW, check rotation of swinging frame, and adjust stop in spoiler aft bell crank bracket as necessary to provide specified swinging frame rotation.

NOTE: One AN960 PD416L washer is the equivalent of approximately 0.36 degree of swinging frame rotation.

(10) If it was necessary to reset spoiler aft bell crank stops in step (9), rotate copilot's control wheel CW and CCW until aft spoiler bell crank stops make contact and adjust cockpit stops at base of copilot's control column as necessary to provide clearance of 0.15 (+0.06, -0.03) inch.

(11) Remove all index pins and test system (refer to 27-3-0, Adjustment/ Test - Spoiler-Speed Brake System Functional Test).

NOTE: If a spoiler aft bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5), and 2.F.(6). Check that bell crank does not bind or stick when control wheel is operated through full travel.

## AILERON INTERCONNECT OUTBOARD IDLER CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Interconnect Outboard Idler Crank (see Figure 201)

   A. Equipment Required.

      (1) Index pins No. 22-J107-2.5, -3.0, and -4.0.

   B. Remove Aileron Interconnect Outboard Idler Crank.

      (1) Open third access door outboard of fuselage on under surface of wing.

      (2) Disconnect inboard and outboard push-pull rods from idler crank.

      (3) Remove idler crank mounting bolt and remove idler crank.

   C. Install Aileron Interconnect Outboard Idler Crank.

      (1) Position idler crank and install mounting bolt.

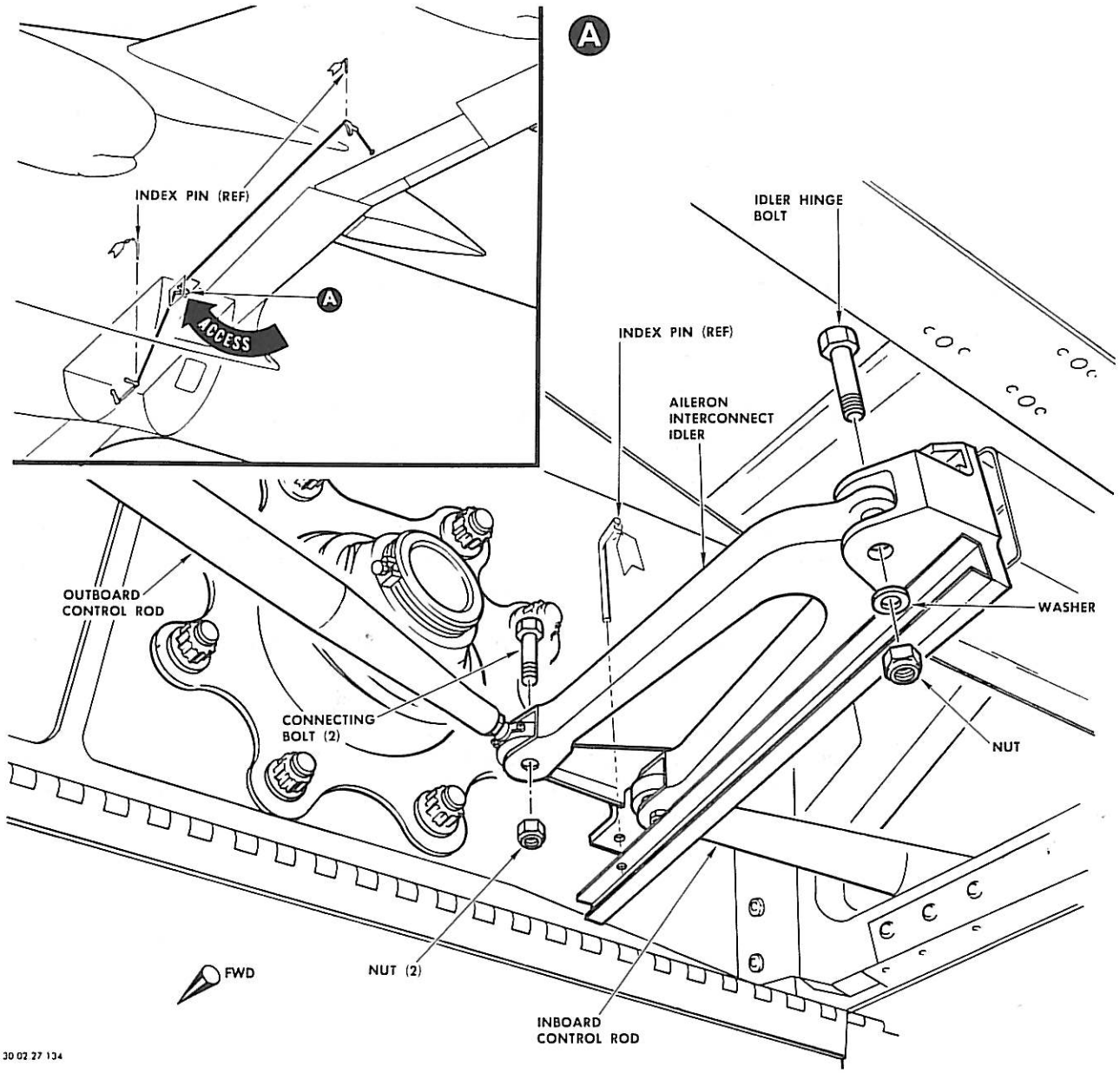
      (2) Open aileron trim linkage access door on under surface of wing.

      (3) Insert index pin No. 22-J107-2.5 in LH inboard idler beneath mixer, index pin No. 22-J107-3.0 in interconnect outboard bell crank, and index pin No. 22-J107-4.0 in aileron interconnect outboard idler crank.

      (4) Adjust length of inboard and outboard push-pull rods as necessary to distance between rigged bell crank and idlers, install on interconnect idler crank, and tighten check nuts.

      (5) Remove three index pins and test system (refer to Adjustment/Test - Aileron System Functional Test).

      NOTE: If an aileron interconnect outboard idler crank only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.C.(1) through 2.C.(16), and 2.D.(5).




Aileron Interconnect Outboard Idler Crank Installation
Figure 201

## AILERON INTERCONNECT INBOARD IDLERS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Interconnect Inboard Idler (see Figure 201)

   A. Equipment Required.

      (1) Index pins No. 22-J107-2.5 and -4.0.

   B. Remove Aileron Interconnect Inboard Idler.

      (1) Gain access to hydraulic compartment.

      (2) Disconnect link connecting LH and RH inboard idlers from inboard idler being removed.

      (3) Disconnect push-pull rod extending outboard from inboard idler being removed.

      (4) Remove mounting bolt and detach idler from idler bracket.

   C. Install Aileron Interconnect Inboard Idler.

      NOTE: Prior to installing idlers, check bearings in idler two-bearing assemblies for evidence of binding on bolts, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

      (1) Position idler and install mounting bolt.

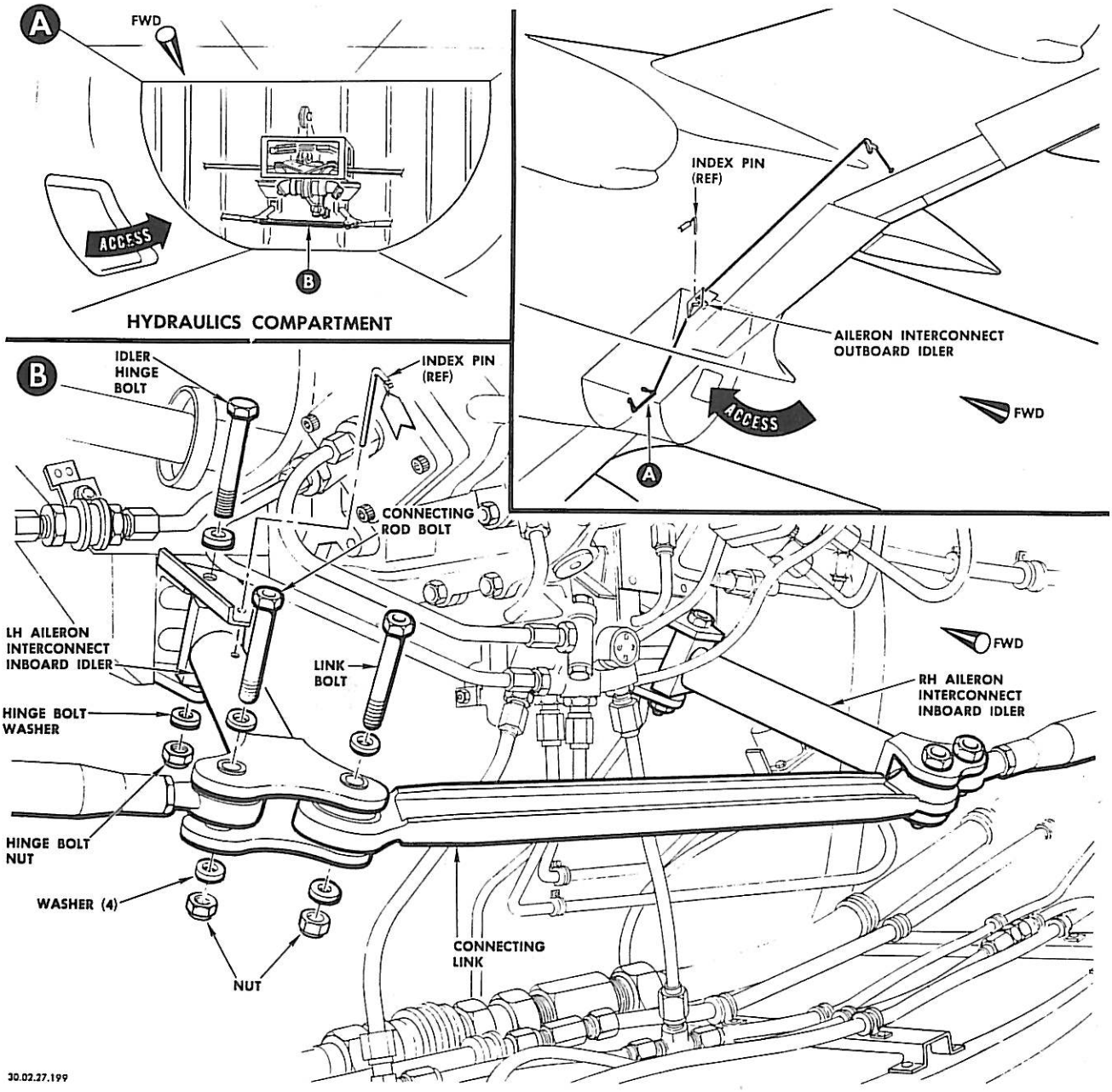
      (2) Install free end of connecting link on idler being installed.

      (3) Insert index pin 22-J107-2.5 in LH inboard idler and index pin 22-J107-4.0 in aileron interconnect outboard idler crank outboard from idler being installed.

      (4) Adjust length of push-pull rod as necessary to distance between rigged idler and idler crank, install free end on inboard idler, and tighten check nut on rod end.

      (5) Remove index pins and test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

         NOTE: If an aileron interconnect inboard idler only has been replaced and no other rigging or adjustment has been changed, check aileron operation per 27-1-0, steps 2.C.(1) through 2.C.(16), and 2.D.(5).




Aileron Interconnect Inboard Idler
Crank Installation
Figure 201

## AILERON INTERCONNECT OUTBOARD BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Interconnect Outboard Bell Crank (see Figure 201)

A. Equipment Required.

(1) Index pins No. 22-J107-2.5 and -4.0.

(2) Protractor No. 30-18001-1 or -2, LH or RH, for measuring aileron deflection. (See 27-1-0, Figure 203).

(3) Straight edge at least four feet long for streamlining aileron with wing.

B. Remove Aileron Outboard Interconnect Bell Crank.

(1) Open aileron trim linkage access door on lower surface of wing.

(2) Using straight edge, streamline RH aileron with wing and flight tab with aileron, install protractor No. 30-18001-2, and adjust protractor to read 0 degrees.

(3) Using straight edge, streamline LH aileron with wing and flight tab with aileron, install protractor No. 30-18001-1, and adjust protractor to read 0 degrees.

(4) With LH aileron and flight tab streamlined, note and record position of RH aileron as indicated by protractor.

NOTE: One-half of the deflection of the RH aileron represents the amount of droop introduced in the aileron interconnect linkage to streamline the ailerons during high-speed flight.

(5) Disconnect push-pull rods from forward and outboard arms of outboard interconnect bell crank.

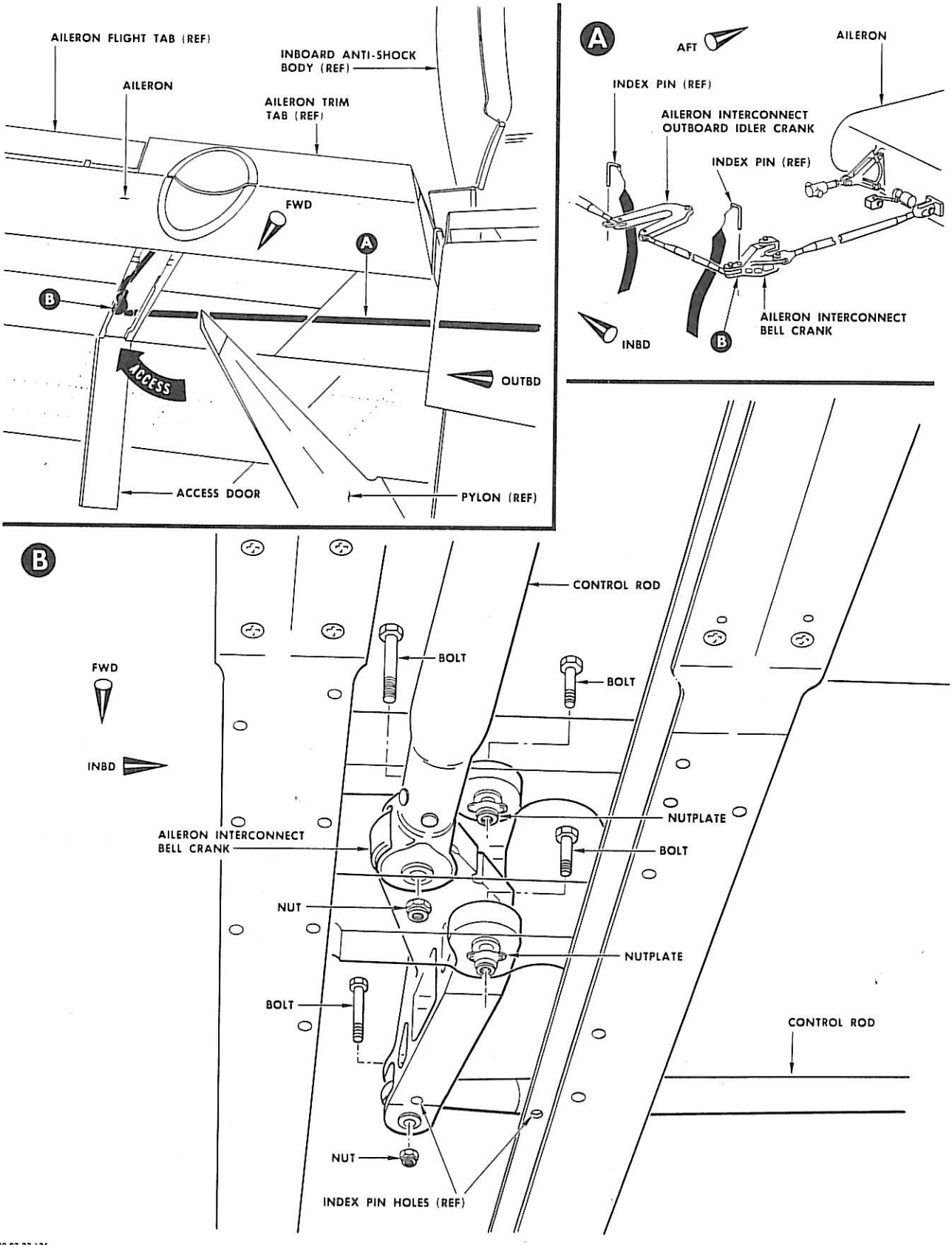
(6) Remove upper and lower hinge bolts and remove bell crank.

C. Install Aileron Outboard Interconnect Bell Crank.

(1) Position bell crank on bracket and install two hinge bolts.

(2) Insert index pin No. 22-J107-2.5 in LH interconnect inboard idler beneath mixer and index pin No. 22-J107-4.0 in outboard interconnect bell crank.

(3) Adjust length of push-pull rod extending inboard from bell crank if necessary to distance between rigged bell cranks, install connecting bolt, and tighten check nut.




Aileron Outboard Interconnect Bell Crank Installation
Figure 201

(4) Remove index pins.

(5) Check that protractors are installed on aileron flight tabs and that each protractor is adjusted to read 0 degrees when aileron is streamlined with wing and flight tab is streamlined with aileron.

(6) Secure either aileron in streamline position and position and secure opposite aileron with same deflection noted in step B.(4).

(7) Adjust length of push-pull rod extending aft from bell crank being installed to length between positioned aileron and bell crank, install bolt connecting push-pull rod to bell crank, and tighten check nut.

(8) Test aileron system (refer to Adjustment/Test - Aileron System Functional Test).

NOTE: If an aileron outboard interconnect bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron friction per 27-1-0, steps 2.C.(1) through 2.C.(16) and 2.D.(5).

## AILERON IDLERS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Idlers (see Figure 201)

   A. Equipment Required.

      (1) Specially calibrated tensiometer for checking tension of 1/8-inch 1 x 19 control cables.

      (2) Index pins 22-J107-3.0, and -4.0.

   B. Remove Aileron Idler.

      (1) Open aileron GUST DAMPER access door on lower surface of wing trailing edge.

      (2) Open first access door inboard of aileron GUST DAMPER access door.

      (3) Loosen one turnbuckle on aileron control cable at aileron flight tab bell crank.

      (4) Detach control cables from inboard and outboard arms of aileron idlers. (Tag cables for installation).

      (5) Remove mounting bolt attaching aileron idlers to bracket and remove aileron idlers.

   C. Install Aileron Idler.

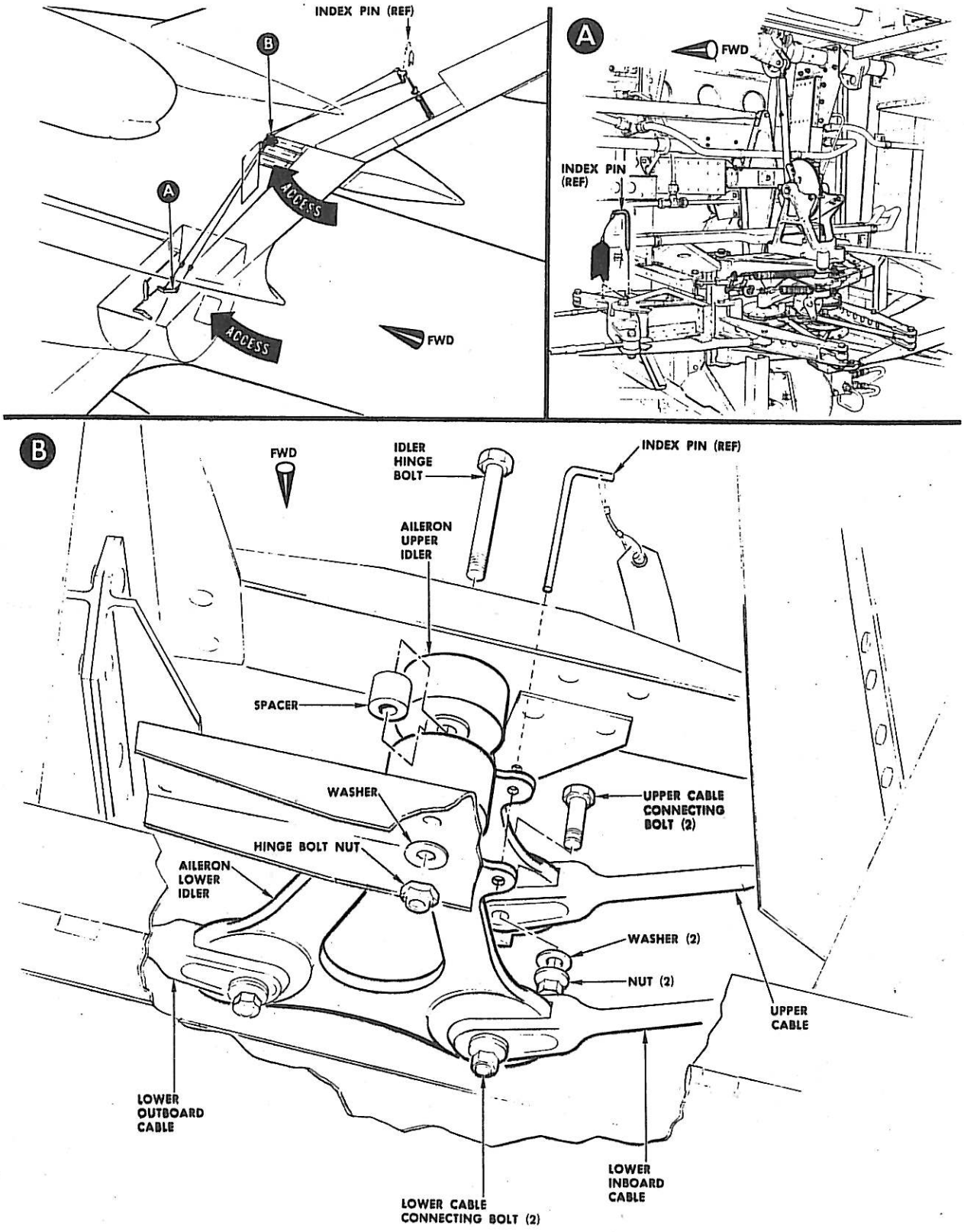
      (1) Position idlers in mounting bracket and install mounting bolt.

      (2) Attach control cables to inboard and outboard arms of idlers and tighten loosened cable at aileron flight tab bell crank to a tension of 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pounds for each degree C) increase or decrease respectively in free air temperature.

      (3) Insert index pin 22-J107-4.0 in aileron horizontal bell crank at mixer and attempt to insert index pin 22-J107-3.0 in lower aileron idler. If index pin cannot be inserted, alternately loosen and tighten cables on each side of lower idler until index pin holes in lower idler and bracket are aligned.

      (4) Attempt to insert index pin 22-J107-3.0 in upper aileron idler. If index pin cannot be inserted, alternately loosen and tighten cables inboard and outboard of upper idler until index pin holes in upper idler and bracket are aligned.

      (5) Attempt to insert index pin 22-J107-3.0 in lower aileron idler. If index pin cannot be inserted, alternately loosen and tighten cables inboard and outboard of lower idler until index pin holes in lower idler and bracket are aligned.


INDEX PIN (REF)
B
A
ACCESS
ACCESS
FWD
A
FWD
INDEX PIN (REF)
B
FWD
IDLER HINGE BOLT
INDEX PIN (REF)
AILERON UPPER IDLER
SPACER
WASHER
UPPER CABLE CONNECTING BOLT (2)
HINGE BOLT NUT
AILERON LOWER IDLER
WASHER (2)
NUT (2)
UPPER CABLE
LOWER OUTBOARD CABLE
LOWER INBOARD CABLE
LOWER CABLE CONNECTING BOLT (2)

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(6) Attempt to insert index pin 22-J107-4.0 in aileron flight tab bell crank. If index pin cannot be inserted, alternately loosen and tighten opposing cables in idler/bell crank circuit until index pin hole in bell crank and bracket are aligned.

(7) When all index pin holes are aligned, recheck cable tension, adjust if necessary, and safety turnbuckles with NAS 651 clips.

(8) Remove all index pins and test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

NOTE: If the aileron idlers only have been replaced and no other rigging or adjustment has been changed, check aileron flight tab operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5) and 2.F.(6). Check that idlers do not bind or stick when control wheel is operated through full travel.

## AILERON FLIGHT TAB BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation - Aileron Flight Tab Bell Cranks (see Figure 201)

   A. Equipment Required.

      (1) Specially calibrated tensiometer for nonflex cables.

      (2) Index pins No. 22-J107-3.0 and -4.0.

      (3) Tools No. 30-44416-901 and -902 for securing aileron hinge line bell cranks in centered position.

   B. Remove Aileron Flight Tab Bell Crank.

      (1) Open flight tab linkage access door and remove aileron gust damper access panel on under surface of wing and aileron hinge line bell crank fairing from leading edge of aileron.

      (2) Loosen one turnbuckle in cable extending inboard from flight tab bell crank and disconnect two cables from flight tab bell crank.

      (3) Disconnect control rod from outboard arm of flight tab bell crank.

      (4) Remove flight tab bell crank mounting bolt and remove bell crank.

   C. Install Aileron Flight Tab Bell Crank.

      NOTE: Prior to installing flight tab bell crank, check bearings in bell crank two-bearing assembly for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

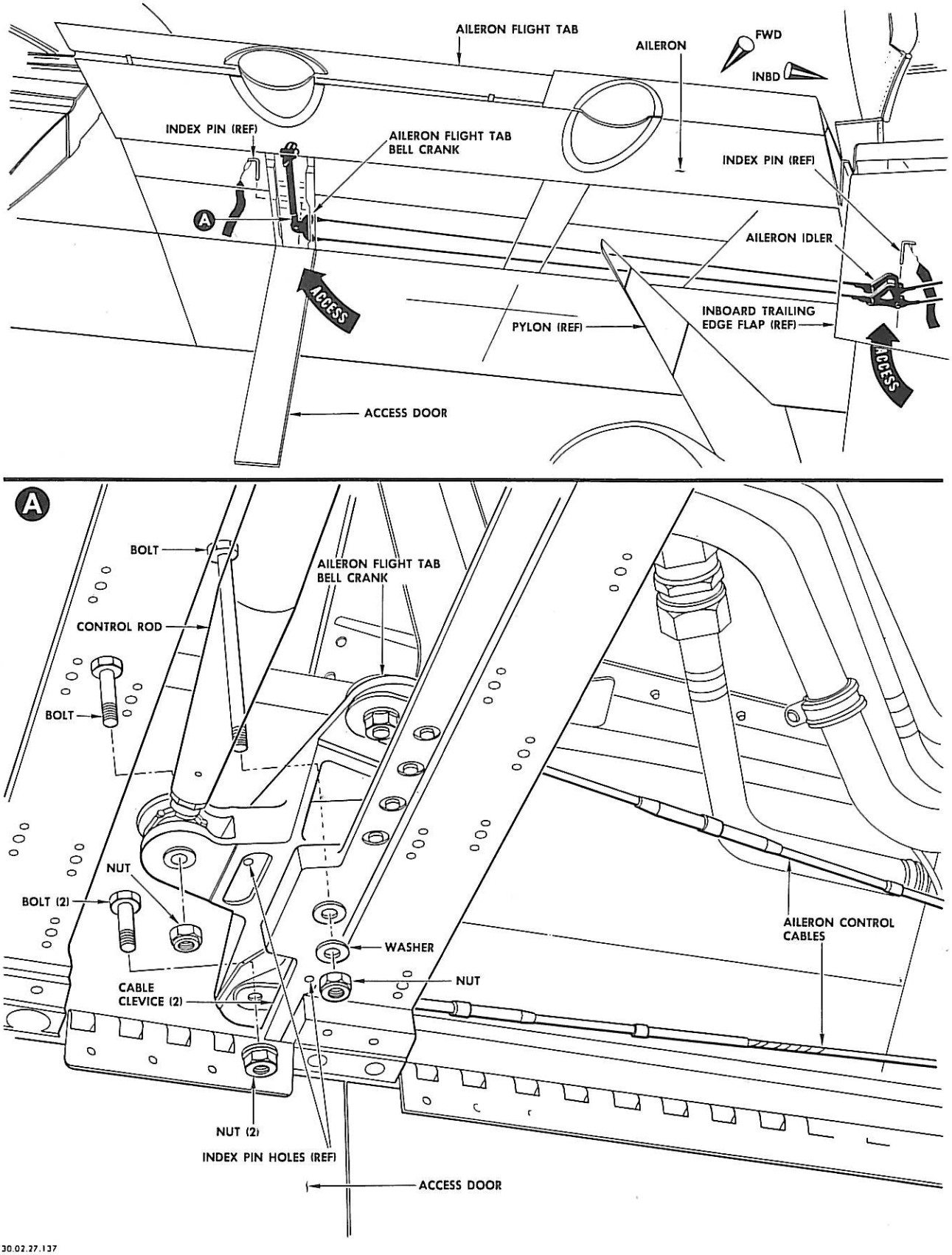
      (1) Position flight tab bell crank and install mounting bolt.

      (2) Attach aileron control cables to flight tab bell crank and tighten loosened turnbuckle until cable tension is 205 (±25) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 1.0 pound for each degree F (2.0 pound for each degree C) increase or decrease respectively in free air temperature.

      (3) Insert index pin 22-J107-4.0 in aileron horizontal bell crank at mixer and attempt to insert index pin 22-J107-3.0 in aileron flight tab bell crank. If index pin cannot be inserted, alternately loosen and tighten opposing cables in cable loop between aileron flight tab bell crank and aileron idlers until index pin hole in flight tab bell crank is aligned with hole in bell crank bracket.

      (4) Attempt to insert index pin 22-J107-3.0 in upper idler. If index pin cannot be inserted, alternately loosen and tighten cables inboard and outboard of idler until index pin in hole in idler is aligned with hole in idler bracket.

      (5) Repeat step (4) substituting lower idler for upper idler.


AILERON FLIGHT TAB
AILERON
FWD
INBD
INDEX PIN (REF)
AILERON FLIGHT TAB BELL CRANK
INDEX PIN (REF)
A
AILERON IDLER
ACCESS
PYLON (REF)
INBOARD TRAILING EDGE FLAP (REF)
ACCESS
ACCESS DOOR
A
BOLT
AILERON FLIGHT TAB BELL CRANK
CONTROL ROD
BOLT
NUT
BOLT (2)
WASHER
NUT
CABLE CLEVICE (2)
AILERON CONTROL CABLES
NUT (2)
INDEX PIN HOLES (REF)
ACCESS DOOR

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(6) Check cable tension, adjust if necessary, and safety with NAS 651 clips.

(7) Install tool No. 30-44416-901 for LH aileron or -902 for RH aileron on aileron hinge line bell crank to secure bell crank in centered position.

(8) Adjust control rod to length between rigged flight tab bell crank and positioned hinge line bell crank, install forward end of control rod on outboard arm of flight tab bell crank, and tighten check nut on rod end.

(9) Remove index pin from aileron horizontal bell crank and rigging tool from hinge line bell crank.

(10) Test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

NOTE: If an aileron flight tab bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron flight tab operation per 27-1-0, steps 2.F.(1), 2.F.(2) 2.F.(3), 2.F.(5) and 2.F.(6). Check that bell crank does not bind or stick when control wheel is operated through full travel.

## AILERON HINGE LINE BELL CRANKS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Hinge Line Bell Cranks (see Figure 201)

A. Equipment Required.

(1) One index pin 22-J107-4.0 or equivalent.

(2) Straight edge at least four feet long for streamlining aileron with wing and flight tab with aileron.

(3) Tool No. 30-44416-901 or -902 (LH or RH) for securing hinge line bell crank in neutral.

B. Remove aileron Hinge Line Bell Crank.

(1) Open flight tab linkage access door on lower surface of wing and remove flight tab hinge fairing from leading edge of aileron and flight tab horn fairing from trailing edge of aileron.

(2) Disconnect forward and aft control rods from hinge line bell crank. Install bolts loosely on control rods for installation.

(3) Secure aileron in "full up" position.

(4) Remove bell crank mounting bolt and remove bell crank.

C. Install Aileron Hinge Line Bell Crank.

NOTE: Prior to installing hinge line bell crank, check bearings in bell crank two-bearing assemblies for evidence of binding on bolt, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

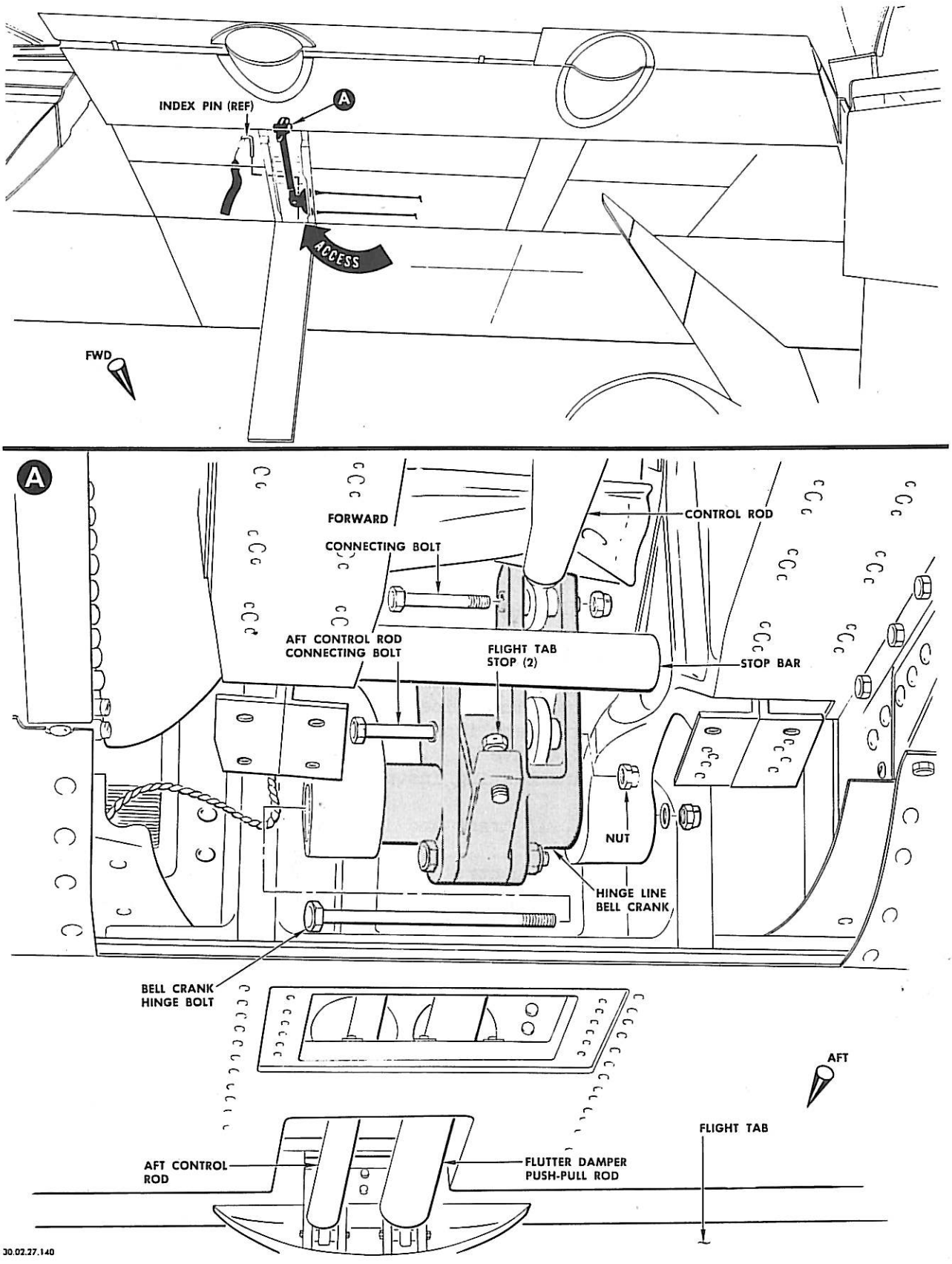
(1) Position hinge line bell crank and install mounting bolt.

(2) Install forward and aft control rods on hinge line bell crank with aft end of forward rod on upper bell crank bearing.

(3) Disconnect forward end of forward control rod from flight tab bell crank and aft end of aft control rod from flight tab horn.

(4) Insert index pin No. 22-J107-4.0 in aileron flight tab bell crank and install tool No. 30-44416 on hinge line bell crank and secure bell crank in neutral position.

(5) Adjust length of forward control rod to distance between rigged bell cranks, tighten check nut on rod end, and install forward end of control rod on flight tab bell crank.






Aileron Hinge Line Bell Crank Installation
Figure 201

(6) Using straight edge, streamline aileron with wing and flight tab with aileron. Secure flight tab in position with respect to aileron.

(7) Adjust length of aft control rod to distance between rigged hinge line bell crank and flight tab horn, tighten check nut on rod end, and install aft end of control rod on flight tab horn.

(8) Remove index pin from flight tab bell crank and rigging tool from hinge line bell crank.

(9) Test aileron system (refer to 27-1-0, Adjustment/Test Aileron System Functional Test).

NOTE: If an aileron hinge line bell crank only has been replaced and no other rigging or adjustment has been changed, check aileron flight tab operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5) and 2.F.(6). Check that bell crank does not bind or stick when control wheel is operated through full travel.

## AILERON FLUTTER DAMPERS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Outboard Flutter Damper (see Figure 201)

A. Equipment Required.

(1) Spring scale suitable for checking damper break out force.

B. Remove Aileron Outboard Flutter Damper.

(1) Remove aileron center and flight tab bell crank fairings from leading edge of aileron and open flight tab linkage access door on under surface of wing. Removing two center screws in aft end of access door frees forward end of hinge seal.

(2) Disconnect flutter damper arm from link connnecting arm to fitting on wing structure. Install bolt loosely in link for installation.

(3) Remove bolt securing flutter damper arm on splined shaft of damper and slide arm from damper shaft.

(4) Remove four bolts connecting damper to aileron structure and remove flutter damper.

NOTE: Note location of spacers (if spacers are used) between flutter damper and aileron structure.

C. Install Aileron Outboard Flutter Damper.

NOTE: Before installing damper in aileron, insert damper splined shaft through serrated opening in damper arm with bolt holes in split end of damper arm aligned with groove in splined shaft. Place crayon reference marks on end of splined shaft and split end of damper arm.

(1) Position flutter damper in aileron, install spacers noted in Step B. (4), and install four mounting bolts.

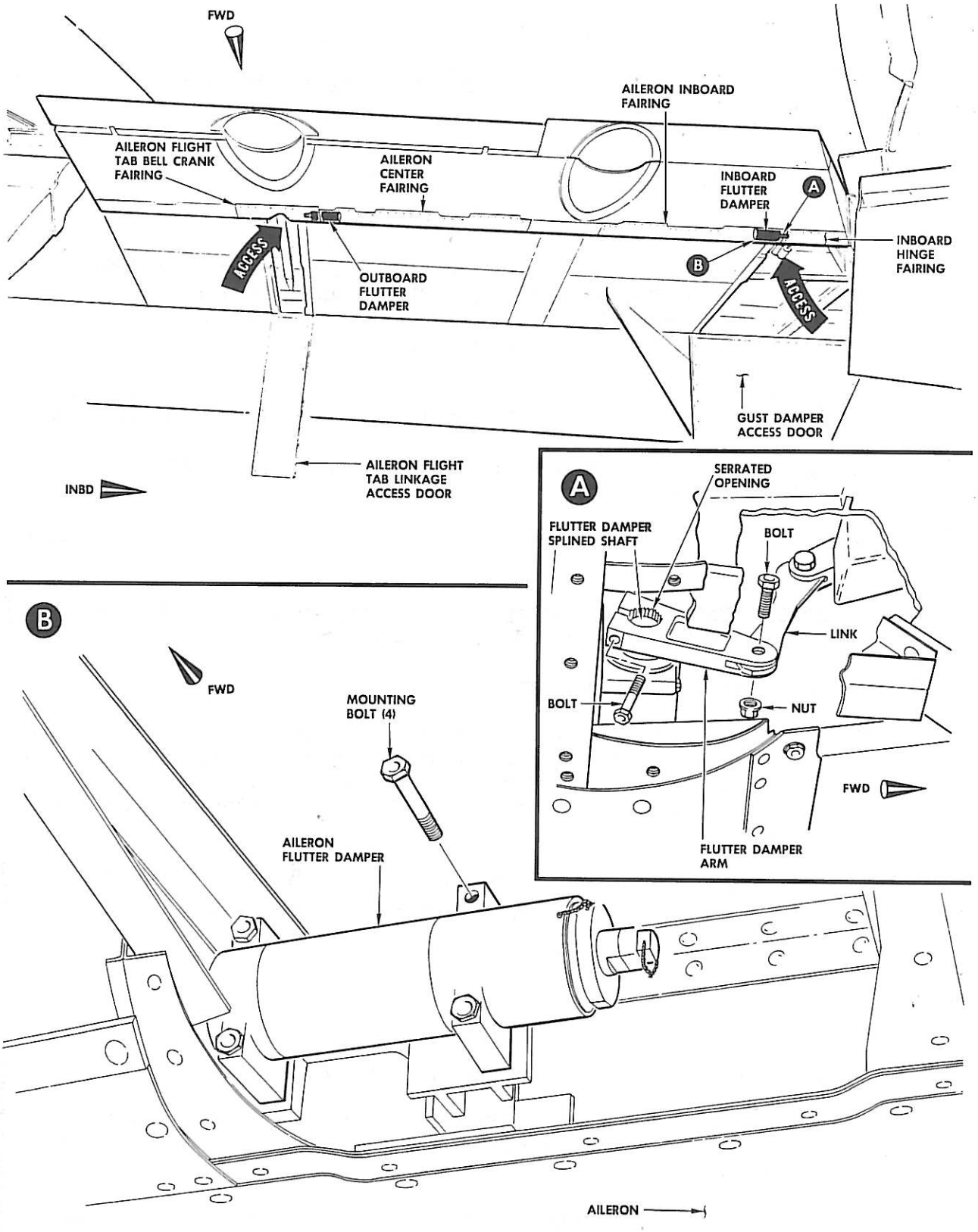
(2) Align crayon marks on arm and splined shaft and slide arm onto splined shaft.

(3) Install bolt securing damper arm on damper shaft.

(4) Check operation of flutter damper as follows:

(a) Attach spring scale to forward end of flutter damper arm. Measure distance from center of damper shaft to scale attach point.

(b) Pull scale at a slow and steady rate in direction of normal arm rotation. Keep scale at 90 degrees to damper arm at all times.


FWD
AILERON INBOARD FAIRING
AILERON FLIGHT TAB BELL CRANK FAIRING
AILERON CENTER FAIRING
INBOARD FLUTTER DAMPER
A
INBOARD HINGE FAIRING
ACCESS
OUTBOARD FLUTTER DAMPER
B
ACCESS
GUST DAMPER ACCESS DOOR
AILERON FLIGHT TAB LINKAGE ACCESS DOOR
INBD
A
SERRATED OPENING
FLUTTER DAMPER SPLINED SHAFT
BOLT
LINK
BOLT
NUT
FWD
FLUTTER DAMPER ARM
B
FWD
MOUNTING BOLT (4)
AILERON FLUTTER DAMPER
AILERON

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(c) Multiply breakout force measured in pounds by the number of inches obtained in step (a). This breakout force shall not exceed 10 inch-pounds.

(d) If breakout force is greater than 10 inch-pounds, install shims as necessary between flutter damper and aileron structure to prevent torquing of flutter damper.

(5) Install bolt connecting flutter damper arm to damper link.

(6) Manually move aileron through full travel; there shall be no restriction.

NOTE: Aileron full travel is 15 degrees "up" and 15 degrees "down". Allow for aileron droop.

2. Removal/Installation Aileron Inboard Flutter Damper (see Figure 201)

A. Equipment Required.

(1) Spring scale suitable for checking damper breakout force.

B. Remove Aileron Inboard Flutter Damper.

(1) Open gust damper access door on under surface of wing and remove inboard hinge fairing from leading edge of aileron.

(2) Disconnect flutter damper arm from link connecting arm to wing structure. Install bolt loosely in link for installation.

(3) Remove bolt securing flutter damper arm on splined shaft of damper and slide arm from damper shaft.

(4) Remove four bolts connecting damper to aileron structure and remove damper.

NOTE: Note location of spacers (if spacers are used) between flutter damper and aileron structure.

C. Install Aileron Inboard Flutter Damper.

NOTE: Before installing damper, insert damper splined shaft through serrated opening in damper arm with bolt holes in split end of damper arm aligned with groove in splined shaft. Place crayon reference marks on end of splined shaft and damper arm as a guide for positioning arm on shaft during installation.

(1) Position flutter damper in aileron with spacers installed as noted in Step B.(4). Install four mounting bolts.

(2) Align crayon marks on arm and splined shaft and install arm on shaft.

(3) Install bolt securing damper arm on splined shaft.

(4) With flutter damper securely mounted in aileron, check flutter damper operation (refer to Removal/Installation Aileron Outboard Flutter Damper, Step C. (4)).

(5) Install bolt connecting flutter damper arm to damper link.

(6) Manually move aileron through full travel; there shall be no restriction.

NOTE: Aileron full travel is 15 degrees "up" and 15 degrees "down". Allow for aileron droop.

3. Removal/Installation - Aileron Flight Tab Flutter Damper (see Figure 202)

A. Equipment Required.

(1) Straightedge at least four feet long for streamlining aileron and flight tab with wing.

(2) Spring scale suitable for checking damper breakout force.

B. Remove Aileron Flight Tab Flutter Damper.

(1) Remove flutter damper access panel from under surface of aileron.

(2) Remove bolt attaching flutter damper arm to push-pull rod.

(3) Remove four bolts attaching flutter damper to aileron structure and remove flutter damper.

NOTE: Note location of spacers (if spacers are used) between flutter damper and damper support bracket.

(4) Remove bolt and detach flutter damper arm from flutter damper.

C. Install Aileron Flight Tab Flutter Damper.

(1) Position arm on flutter damper and install bolt securing arm on damper.

(2) Position flutter damper in aileron with spacers installed as noted in Step B.(3). Install four mounting bolts.

CONVAIR MODEL 30

MAINTENANCE MANUAL

TEMPORARY REVISION NO. 27-102

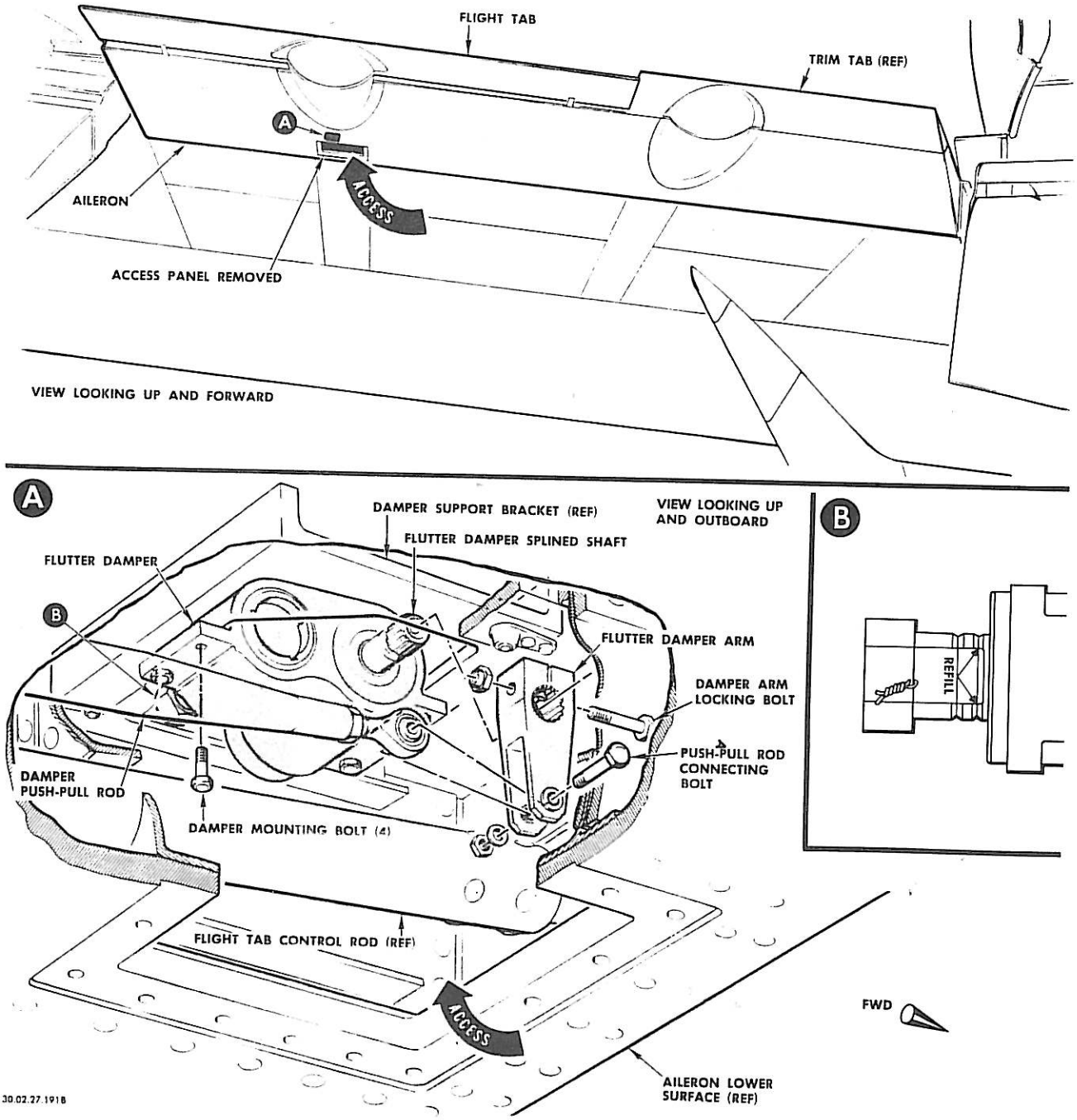
Insert facing 27-1-13, Page 205, dated June 15/64 (or subsequent).

This temporary revision is applicable to airplanes not incorporating Lionel Pacific Service Bulletin No. 27-001.

For airplanes incorporating Lionel Pacific Service Bulletin No. 27-001, use the information on Page 202.

Page 202, delete view B and check damper fluid level as follows:

> Measure the distance between reservoir body and surface of plunger end cap nearest reservoir body. If dimension measured is 0.45 inch or greater, damper may continue in service. (Use of a Go-No-Go gage or inside calipers of 0.45 inch width is recommended.)
>
> If the distance, as measured above, is less than 0.45 inch, remove and refill damper.






Aileron Flight Tab Flutter Damper Installation
Figure 202

(3) Check operation of flutter damper as follows:

(a) Attach spring scale to lower end of flutter damper arm. Measure distance from center of damper shaft to scale attach point.

(b) Pull scale at a slow and steady rate in direction of normal arm rotation. Keep scale at 90 degrees to damper arm at all times.

(c) Multiply breakout force measured in pounds by the number of inches obtained in step (a). This breakout force shall not exceed three and one-tenth inch-pounds.

(d) If breakout force is greater than three and one-tenth inch-pounds, install shims as necessary between flutter damper and damper support bracket to prevent torquing of flutter damper.

(4) Using straightedge, streamline aileron with wing and flight tab with aileron.

(5) Align bolt hole in flutter damper arm with bolt holes in forward end of push-pull rod and check that arm forms an angle of approximately 90 degrees with push-pull rod. If not adjust length of push-pull rod as necessary, install forward end of push-pull rod on damper arm, and tighten check nut on push-pull rod end.

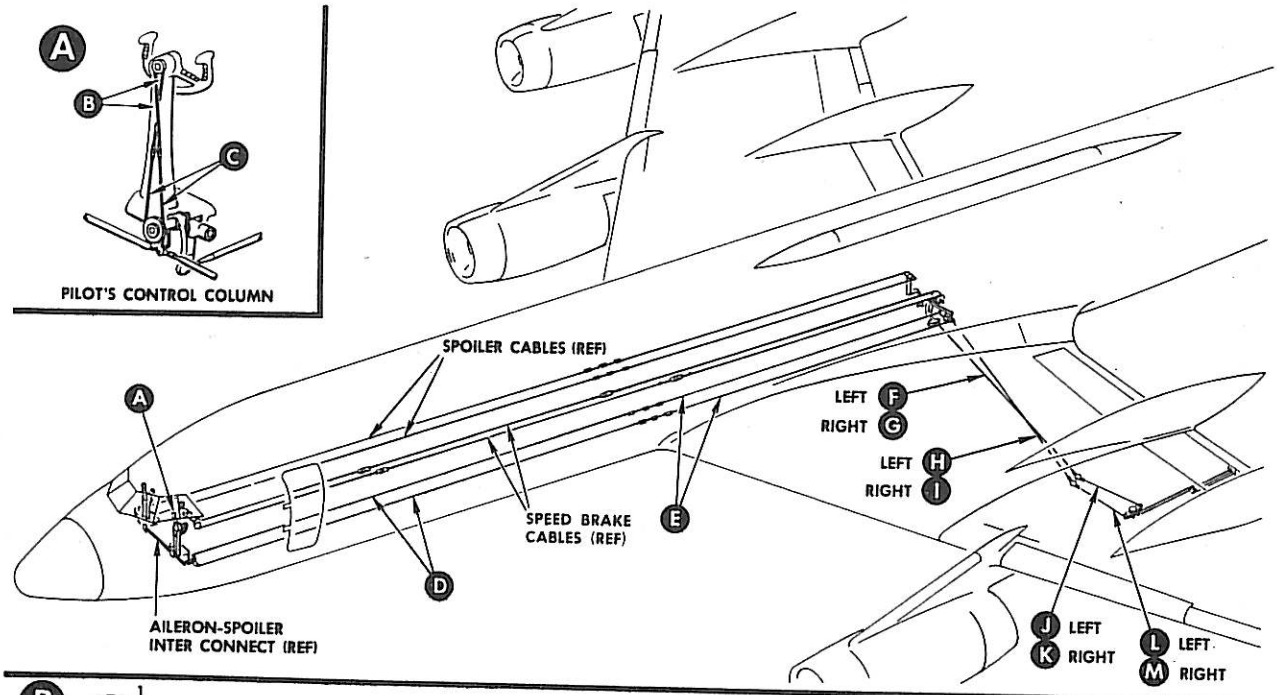
(6) Test aileron system (refer to 27-1-0, Adjustment/Test - Aileron System Functional Test).

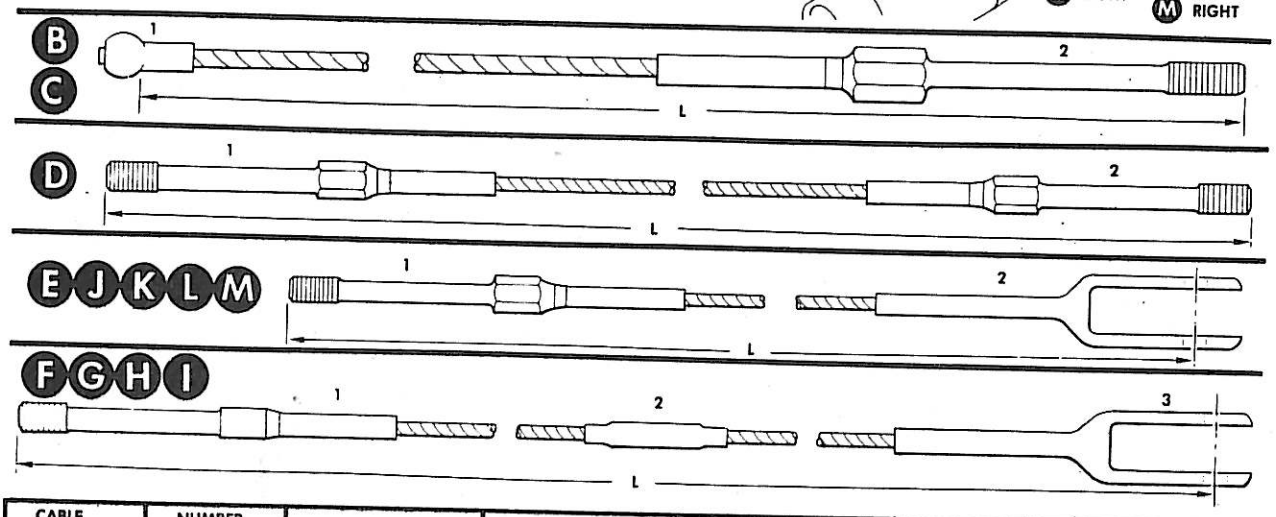
NOTE: If an aileron flight tab flutter damper only has been replaced and no other rigging or adjustment has been changed, check aileron flight tab operation per 27-1-0, steps 2.F.(1), 2.F.(2), 2.F.(3), 2.F.(5) and 2.F.(6).

## 4. Adjustment/Test Unit Servicing

A. General.

Flutter dampers should not be serviced while on the airplane. When the refill line on the fluid level indicator disappears from view, the unit should be removed and a serviceable flutter damper installed.




| CABLE REFERENCE | NUMBER REQUIRED | LENGTH | CABLE SIZE | FITTINGS 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| B | 2 | 24.85 | 1/8 × 7 × 19 | AN 664C4 | NAS 650-S4RH | |
| C | 2 | 16.50 | 1/8 × 7 × 19 | AN 664C4 | NAS 650-S4LH | |
| D | 2 | 393.72 | 1/8 × 1 × 19 | NAS 650-L4LH | NAS 650-S4RH | |
| E | 2 | 341.20 | 1/8 × 1 × 19 | NAS 650-S4LH | AN 658-4 | |
| F | 1 | 200.20 | 1/8 × 1 × 19 | 22-40918 | 22-40911-591 | AN658-4 |
| G | 1 | 200.20 | 1/8 × 1 × 19 | 22-40918 | 22-40911-591 | AN658-4 |
| H | 1 | 195.90 | 1/8 × 1 × 19 | 22-40935-9 | 22-49011-591 | 22-40918-7 |
| I | 1 | 196.20 | 1/8 × 1 × 19 | 22-40935-9 | 22-49011-591 | 22-40918-7 |
| J | 1 | 105.00 | 1/8 × 1 × 19 | NAS 650-L4RH | AN 658-4 | |
| K | 1 | 105.00 | 1/8 × 1 × 19 | NAS 650-L4RH | AN 658-4 | |
| L | 1 | 110.65 | 1/8 × 1 × 19 | NAS 650-L4LH | 22-40935-9 | |
| M | 1 | 110.65 | 1/8 × 1 × 19 | NAS 650-L4LH | 22-40935-9 | |

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# AILERON TRIM SYSTEM - DESCRIPTION AND OPERATION

## 1. General

The aileron trim system is operated by turning the aileron trim control knob on the aft face of the pilots' pedestal (see Figure 1). This knob is geared to a cable drum mounted inside the pedestal. The cables on this drum are routed below the flight compartment floor where they run aft to the wing and then outboard through pressure seals to another drum mounted in the trailing edge of each wing. Each of these drums drives two threaded shafts connected to dual push-pull rods that raise and lower the trim tabs. The trim tab linkage also provides for automatic servo action of the trim tabs when the ailerons are deflected. An aileron trim indicator geared to the trim knob indicates the setting of the trim tab.

## 2. Aileron Trim Tab Travel

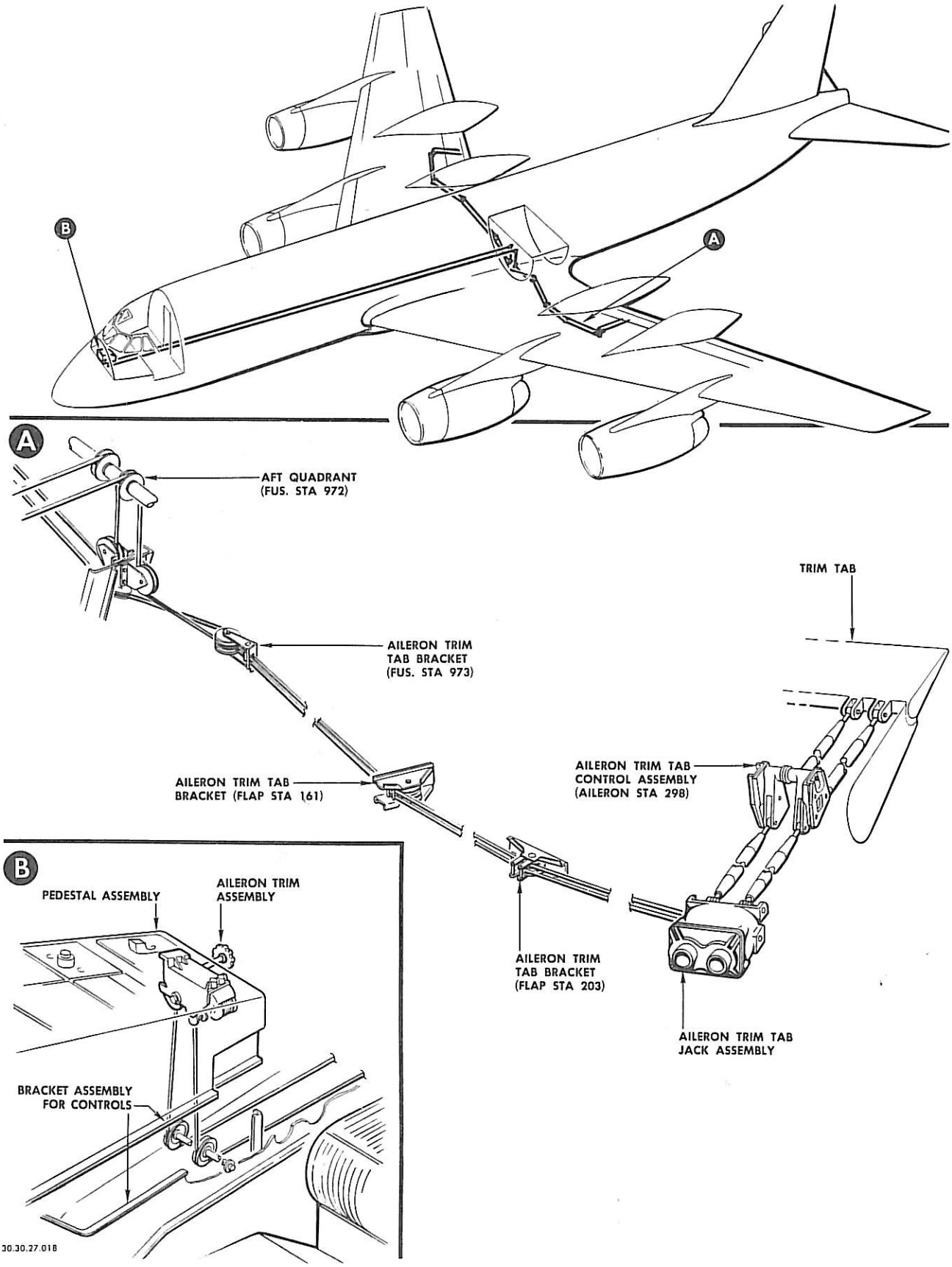
The aileron trim tabs can be adjusted 16.5 degrees "up and down" from streamline by the trim control knob on the pilots' pedestal. In addition, the trim tab linkage provides a servo action opposite in direction to and at one-half the rate of aileron deflection. When one aileron is deflected the full 15 degrees "up", the trim tab servos $7\frac{1}{2}$ degrees "down".

## 3. Aileron Trim Control Knob and Gearbox

The aileron trim control knob is mounted on a horizontal shaft just below the top of the pedestal on the aft side, at the airplane centerline. The shaft, which has a gear ratio of two-to-one, is geared to a parallel shaft attached to the cable drum. The drum shaft also incorporates a gear that drives the trim indicator dial. The overall gear ratio between the knob and the dial is 5 to 62 (1 to 12.4). Stop washers are mounted inside the drum to limit drum travel to five full turns in either direction. This assembly also includes the drum and gearing for the rudder trim tab. Trim knob travel is approximately 10-1/2 turns from stop to stop.

## 4. Aileron Trim Jack

Each aileron trim jack consists of a cable drum interconnected with dual screw jacks. The cable drum is mounted on a serrated shaft along with a spur gear. This gear meshes with another spur gear on a parallel shaft to provide push-pull output motion. Each outer shaft acts as a nut on the threaded inner shaft. As each outer shaft turns, its inner shaft moves forward or aft. Rotation of the inner shaft is prevented by serrations in the housing.


B
A
A
AFT QUADRANT
(FUS. STA 972)
AILERON TRIM
TAB BRACKET
(FUS. STA 973)
AILERON TRIM TAB
BRACKET (FLAP STA 161)
TRIM TAB
AILERON TRIM TAB
CONTROL ASSEMBLY
(AILERON STA 298)
AILERON TRIM
TAB BRACKET
(FLAP STA 203)
AILERON TRIM TAB
JACK ASSEMBLY
B
PEDESTAL ASSEMBLY
AILERON TRIM
ASSEMBLY
BRACKET ASSEMBLY
FOR CONTROLS
30.30.27.018

## AILERON TRIM SYSTEM - TROUBLE SHOOTING

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 1. AILERON TRIM TABS ARE NOT EVEN WHEN TRIM INDICATOR READS ZERO | |
| A. Aileron trim tab indicator is not set properly. | Turn trim control knob on pilot's pedestal until trim cables are wrapped equally on each side of cable drum in the pedestal. Check position of indicator dial. If dial does not read zero, remove cover and gear box assembly, then pull dial aft and rotate to read zero. If dial reads zero when cables are wrapped equally on each side of drum, trouble is elsewhere. |
| B. Trim tab control rods not properly adjusted. | Disconnect aft ends of trim tab control rods from trim tab horns and streamline ailerons with wings and aileron trim tabs with ailerons. With trim control indicator on zero and proper trim jack shaft extension (1.93 (± 0.03) inch), attempt to insert index pins through bell cranks in control assemblies at aileron station 298, each wing. If any index pin can not be inserted (two each wing), disconnect forward end of rod connecting control assembly to trim jack shafts and insert index pin in control assembly. Adjust control rod(s) to length between rigged control assemblies and positioned trim jack(s). Tighten lock nuts on control rod ends and reinstall on trim jack shafts. Adjust previously disconnected trim tab control rods to length between rigged control assemblies and trim tab horns. Tighten lock nut and install aft ends of control rods on trim tab horns. |

WARNING: WHEN ANY ADJUSTMENT IS ALTERED OR COMPONENTS DISCONNECTED DURING TROUBLE SHOOTING, THE SYSTEM MUST BE FUNCTIONALLY TESTED. REFER TO ADJUSTMENT/TEST AILERON TRIM SYSTEM.

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 2. EXCESSIVE FORCE REQUIRED TO TURN AILERON TRIM KNOB | |
| A. Aileron trim cables too tight. | Measure tension of trim cables with tensiometer. Tension should measure 50 (±5.0 pounds at 70 degrees F (21 degrees C). Temperature compensation rate is 0.25 pound per degree F (0.50 pound per degree C). If tension is incorrect, adjust cables to proper tension (refer to Adjustment/Test Aileron Trim System). If cable tension is correct, trouble is elsewhere. |
| B. Aileron trim tab control rods are not adjusted evenly, resulting in excessive friction in trim jacks. | Disconnect one trim tab control rod from trim tab horn and test aileron trim knob for free movement. If force required to turn trim knob is normal, adjust length of disconnected trim tab control rod and install on trim tab horn (refer to Adjustment/Test Aileron Trim System). |
| C. Trim cable pulley binding. | While trim control knob is being turned, observe trim cable pulleys to make sure that all pulleys are turning. If frozen pulley is detected, relieve tension in trim cable system and replace defective pulley. If all pulleys move, relieve tension in trim cable system and check each trim cable pulley for free movement. Replace faulty pulley as indicated, and rig trim cable system (refer to Adjustment/Test Aileron Trim System). |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 2. ONE OF THE AILERON TRIM TABS DOES NOT CENTER WHEN AILERON TRIM INDICATOR IS SET AT ZERO (CONT) | |
| C. Control rods of faulty trim tab not adjusted properly. | Disconnect aft ends of trim tab control rods from trim tab horns on faulty trim tab. Streamline ailerons with wings, and aileron trim tabs with ailerons. With trim control indicator on zero and proper trim jack shaft extension (1.86 (±0.03) inch), attempt to insert index pins through bell cranks in control assembly at aileron station 298. If either index pin can not be inserted, disconnect forward end of rod(s) connecting control assembly to trim jack shaft(s) and insert index pin(s) in control assembly. Adjust control rod(s) to length between rigged control assembly and positioned trim jack. Tighten lock nuts on control rod ends and reinstall on trim jack shafts. Adjust previously disconnected trim tab control rods to length between rigged control assembly and trim tab horns. Tighten lock nuts and install aft ends of control rods on trim tab horns. |
| 3. EXCESSIVE FORCE REQUIRED TO TURN AILERON TRIM KNOB | |
| A. Aileron trim cables too tight. | Measure tension of trim cables with tensiometer. Tension should measure 50 (±5.0 pounds at 70 degrees F (21 degrees C). Temperature compensation rate is 0.25 pound per degree F (0.50 pound per degree C). If tension is incorrect, adjust cables to proper tension (refer to Adjustment/Test Aileron Trim System). If cable tension is correct, trouble is elsewhere. |
| B. Aileron trim tab control rods are not adjusted evenly, resulting in excessive friction in trim jacks. | Disconnect one trim tab control rod from trim tab horn and test aileron trim knob for free movement. If force required to turn trim knob is normal, adjust length of disconnected trim tab control rod and install on trim tab horn (refer to Adjustment/Test Aileron Trim System). |

| POSSIBLE CAUSE | ISOLATION PROCEDURE AND CORRECTION |
|---|---|
| 3. EXCESSIVE FORCE REQUIRED TO TURN AILERON TRIM KNOB (CONT) | |
| C. Trim cable pulley binding. | While trim control knob is being turned, observe trim cable pulleys to make sure that all pulleys are turning. If frozen pulley is detected, relieve tension in trim cable system and replace defective pulley. If all pulleys move, relieve tension in trim cable system and check each trim cable pulley for free movement. Replace faulty pulley as indicated, and rig trim cable system (refer to Adjustment/Test Aileron Trim System). |

## AILERON TRIM SYSTEM - MAINTENANCE PRACTICES

1. Adjustment/Test-Adjust Aileron Trim System (see Figure 201)

A. Equipment Required.

(1) Standard cable tensiometer.

(2) Thermometer.

(3) Straightedge at least 4 feet long.

(4) Four index pins No. 22-J107-2 or equivalent.

B. Procedure.

(1) Disconnect push-pull rods at trim tab screw jacks and at trim tab horns. Remove clevises from screw jack shafts.

(2) Turn control knob on pilots' pedestal until cables are wrapped equally on each side of pedestal cable drum (at least three turns from cable fitting slot).

(3) Check position of indicator dial on top of pedestal. If dial does not indicate zero, remove cover from gearbox assembly, then pull dial aft and rotate to indicate zero. Install cover on gearbox.

(4) Check to see that screw jack cable drums in wings have three and one-third turns of cable on each side and that shaft ends extend 1.93 (±0.03) inch from screw jack housing with dial on pilots' pedestal set at zero.

(5) Tighten turnbuckles on tab cables equally until 50 (±5) pounds tension at 70 degrees F (21 degrees C) is obtained. Increase or decrease specified cable tension 0.25 pound for each degree F (0.50 pound for each degree C) increase or decrease respectively in free air temperature.

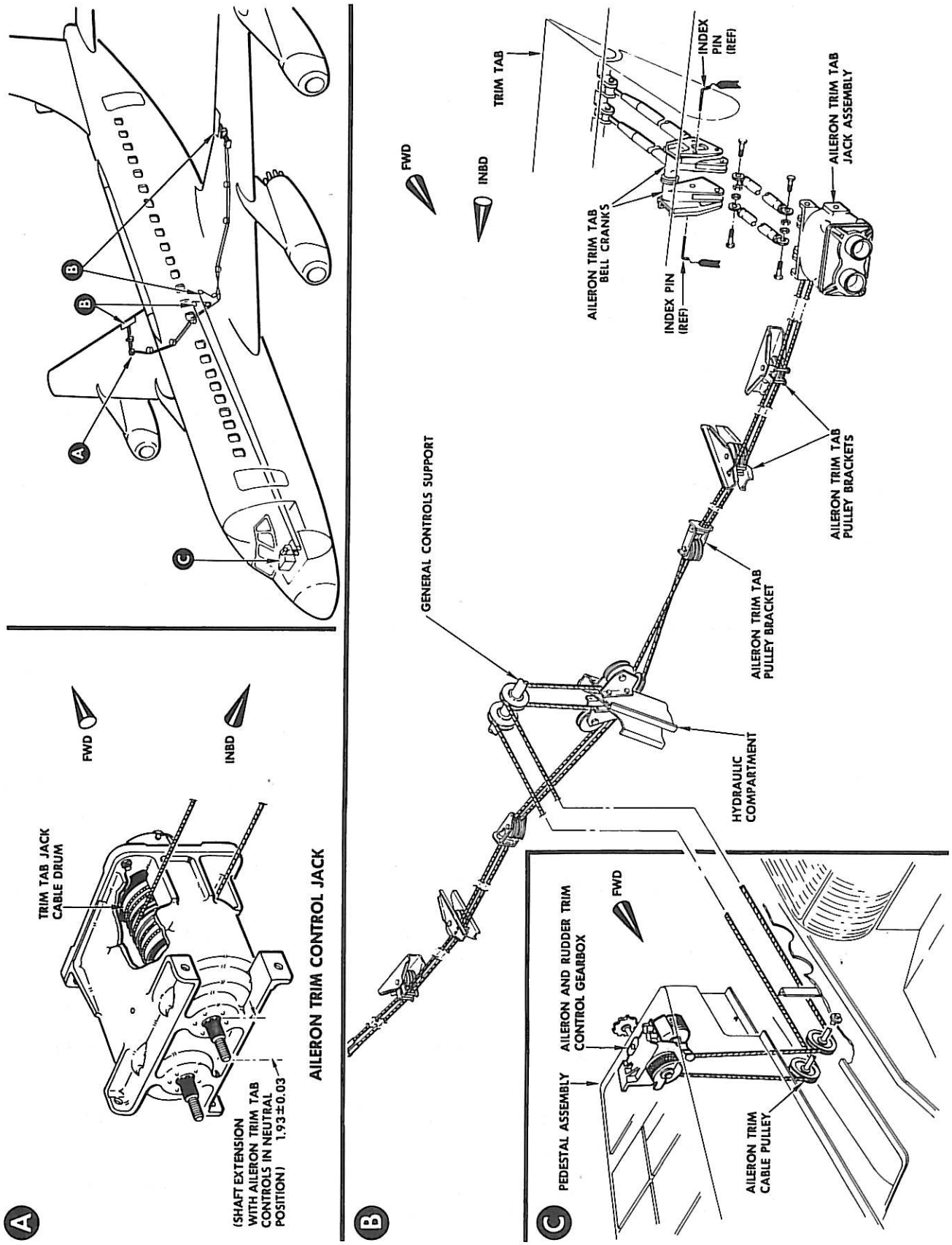
(6) Check protrusion at shaft ends to determine that wing drums have not rotated excessively.

(7) Install clevises on screw jack shafts and tighten lock nuts.

(8) Using straightedge, streamline LH aileron with wing and trim tab with aileron.

(9) Insert index pins No. 22-J107-2.0 through LH aileron trim tab bell cranks (see Figure 201).

(10) Adjust push-pull rods in LH wing to length between screw jack shafts and rigged bell cranks, and reinstall.


A
B
C
FWD
INBD
TRIM TAB JACK CABLE DRUM
(SHAFT EXTENSION WITH AILERON TRIM TAB CONTROLS IN NEUTRAL POSITION) 1.93±0.03
AILERON TRIM CONTROL JACK
TRIM TAB
INDEX PIN (REF)
AILERON TRIM TAB JACK ASSEMBLY
AILERON TRIM TAB BELL CRANKS
INDEX PIN (REF)
GENERAL CONTROLS SUPPORT
AILERON TRIM TAB PULLEY BRACKETS
AILERON TRIM TAB PULLEY BRACKET
HYDRAULIC COMPARTMENT
PEDESTAL ASSEMBLY
AILERON AND RUDDER TRIM CONTROL GEARBOX
AILERON TRIM CABLE PULLEY

(11) Adjust push-pull rods to length between each trim tab horn and rigged bell crank and reinstall.

(12) Remove index pins from bell cranks.

(13) Repeat steps (8) through (12), substituting RH for LH.

(14) Check direction of tab travel by turning the control knob in the flight compartment in a clockwise direction. The trim tab in the left wing should move up and the trim tab in the right wing should move down. Refer to Figure 202 for trim tab travel data.

(15) Safety turnbuckles in cable assemblies with NAS 651 clips and perform a functional test.

2. Adjustment/Test - Aileron Trim System Functional Test

A. Equipment Required.

(1) Straightedge at least 4 feet long to streamline ailerons with wing and trim tabs with ailerons.

(2) Protractors No. 30-18001-1 and -2 (LH and RH) for measuring aileron deflection.

(3) Trim knob loading tool No. 22-04304-19 (see Figure 203).

(4) Dial indicator for measuring free play in trim tab linkage.

(5) Spring scale calibrated from 0 to 30 pounds.

(6) Thermometer calibrated in degrees F or C.

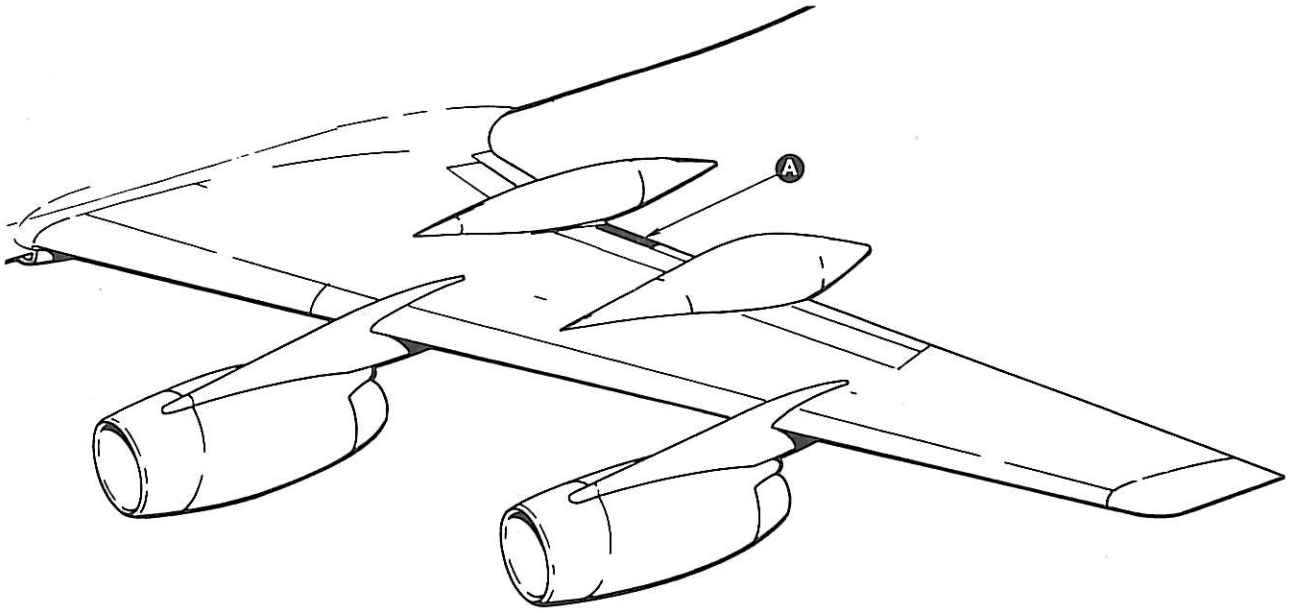
(7) Standard cable tensiometer for measuring tension of 3/32 inch 7 x 7 control cables.

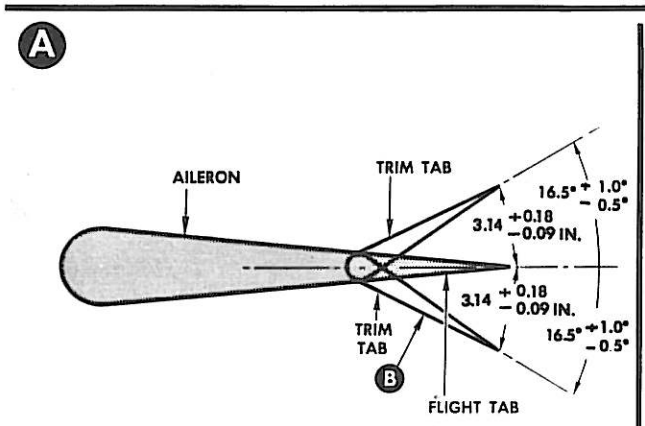
(8) Check gages 30-18001-903 and -904 to measure trim tab travel.

B. Preoperational Check.

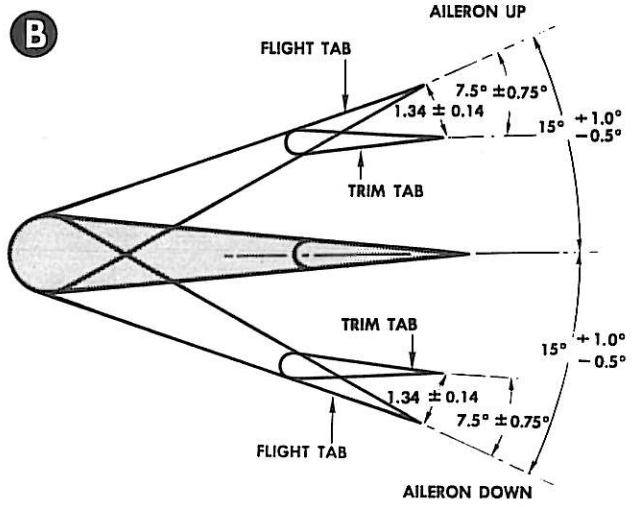
(1) Visually inspect aileron trim system for proper installation of fairleads, pulleys, drums cranks, terminals, pressure seals, turnbuckles, cable guards, etc. Check that all installations requiring safety wire are properly safetied and that all turnbuckles are safetied with safety clips.

(2) Using standard tensiometer, check that tension of aileron trim cables is 50 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease cable tension value 0.25 pounds for each degree F (0.50 pounds for each degree C) increase or decrease respectively in free air temperature.




AILERON TRIM TAB TRAVEL




AILERON TRIM TAB (SERVO ACTION)

| | ANGULAR DEFLECTION | | LINEAR DEFLECTION | | LOCATION OF POINT ON SURFACE FOR DETERMINING LINEAR MEASUREMENTS |
|---|---|---|---|---|---|
| | UP | DOWN | UP | DOWN | |
| AILERON TRIM TAB | 16.5° +1.0° −0.5° | 16.5° +1.0° −0.5° | 3.14 +0.18 −0.09 INCH | 3.14 +0.18 −0.09 INCH | SEE NOTE 1 |
| AILERON TRIM TAB (SERVO ACTION) | 7.5° ±0.75° | 7.5° ±0.75° | 1.34 ±0.14 INCH | 1.34 ±0.14 INCH | SEE NOTE 2 |

**NOTE 1** AILERON TRIM TAB
LINEAR MEASUREMENT IS TAKEN FROM A CENTER POINT ON TRIM TAB OUTBOARD TRAILING EDGE TO A CENTER POINT ON FLIGHT TAB INBOARD TRAILING EDGE WITH FLIGHT TAB STREAMLINE WITH AILERON AND AILERON STREAMLINE WITH WING.

**NOTE 2** AILERON TRIM TAB (SERVO ACTION)
LINEAR MEASUREMENT IS TAKEN FROM A CENTER POINT ON TRIM TAB OUTBOARD TRAILING EDGE TO A CENTER POINT ON FLIGHT TAB INBOARD TRAILING EDGE WITH AILERON IN FULL UP OR DOWN POSITION. MOVEMENT OF THE AILERON MUST BE MADE WITHOUT USE OF THE CONTROLS.

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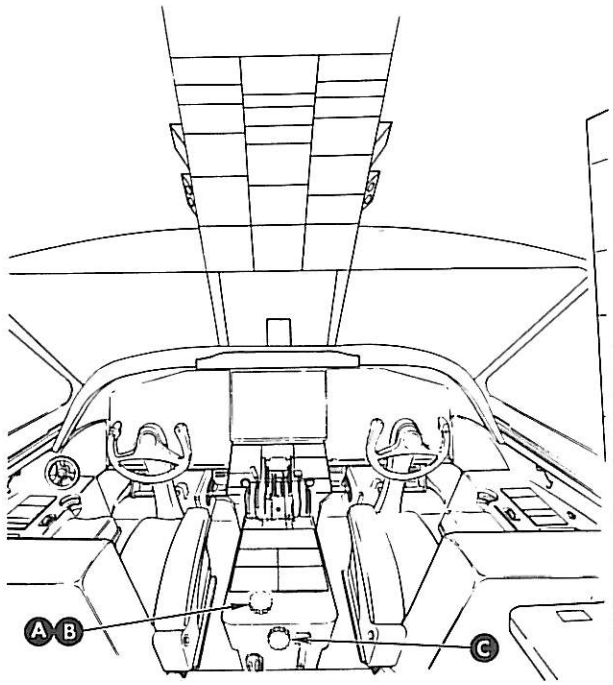
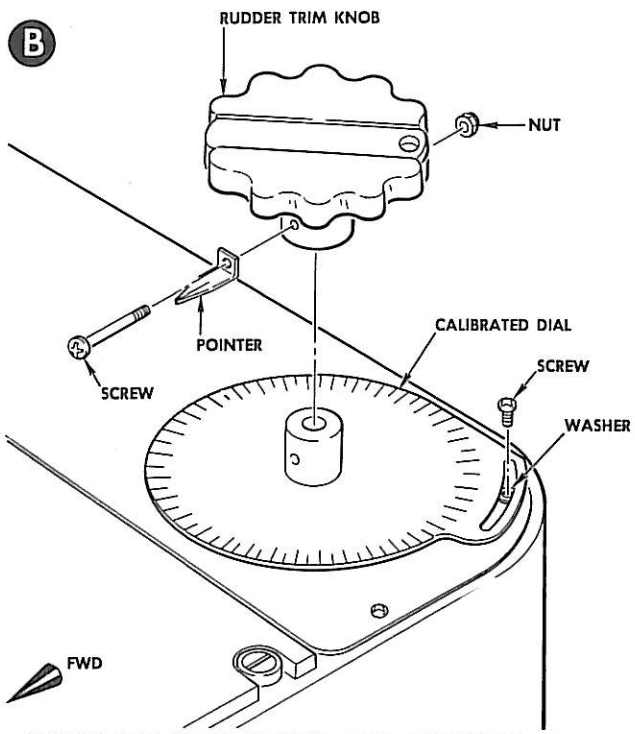
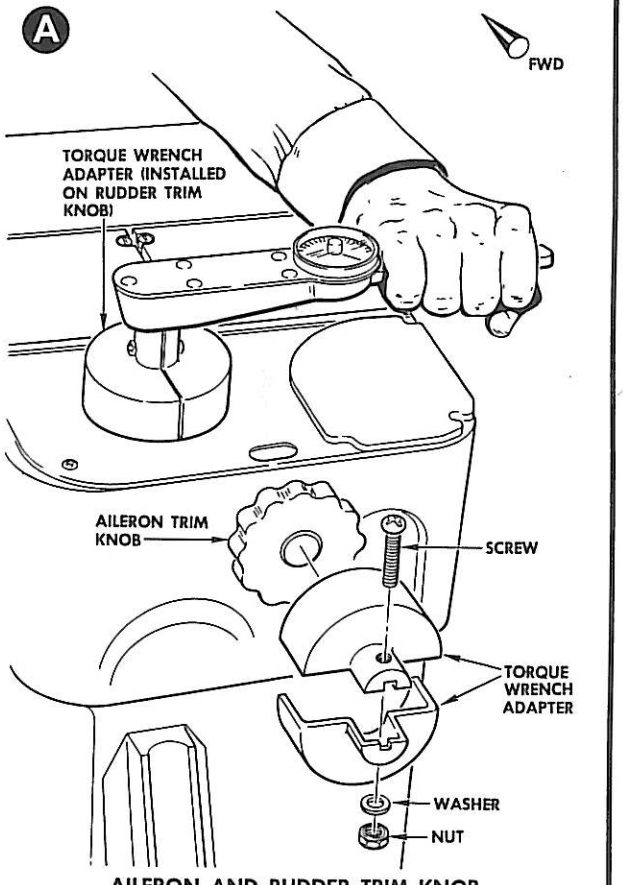



RUDDER TRIM KNOB POINTER AND CALIBRATED DIAL




AILERON AND RUDDER TRIM KNOB TORQUE WRENCH ADAPTER

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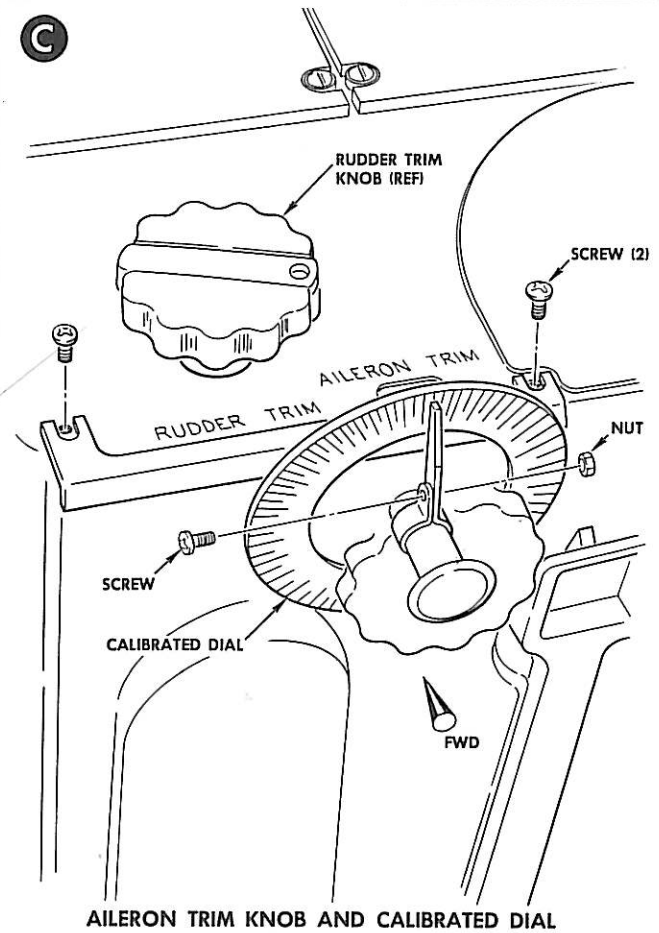



AILERON TRIM KNOB AND CALIBRATED DIAL

C. Test Aileron Trim System Rigging.

(1) Install protractor 30-18001-1 on LH aileron flight tab.

(2) Using straightedge, streamline LH aileron with wing and flight tab with aileron and adjust protractor to read 0°.

(3) Repeat steps (1) and (2) substituting RH for LH and -2 for -1.

(4) Install check gages 30-18001-903 and -904 on LH and RH ailerons and determine that gages indicate 0° when trim tabs are streamlined with ailerons.

(5) Maintain RH aileron and flight tab in streamline position and record reading of protractor on LH aileron flight tab. One-half the difference between the indications of the two protractors represents the amount of droop incorporated in the aileron interconnect linkage to maintain the ailerons in streamline position during high speed flight.

(6) If indicated droop exceeds 0.125 degree, proceed with step (7); if not, omit step (7) and continue with step (8).

(7) Support ailerons, disconnect aileron interconnect push-pull rod from LH aileron interconnect inboard idler in hydraulic compartment, lengthen rod end as required to streamline both ailerons, and connect push-pull rod to inboard idler temporarily. Record number of turns of rod end required.

(8) Place control wheels in neutral, position aileron trim knob at 0°, and check that trim tabs are at 0° (±0.5)° as indicated by check gages.

(9) Continue with aileron trim system checks as indicated in Table 1.

(10) If aileron interconnect linkage was changed in step (7), adjust push-pull rod end at aileron interconnect inboard idler to restore droop but check that final aileron position does not exceed 1.5 degrees down to 0.5 degree up from streamline with wings (ailerons symmetrical).

TABLE I

| TEST NO. | TRIM KNOB POSITION (DIAL INDICATOR READINGS) | AILERON POSITION | TRIM TAB POSITION | |
|---|---|---|---|---|
| | | | LH | RH |
| 1 | 0° | Streamline | 0° ± 0.5° | 0° ± 0.5° |
| 2 | 4° RWD | Streamline | 4° ± 0.5° Up | 4° ± 0.5° Dn |
| 3 | 12° RWD | Streamline | 12° $\pm \frac{1.0°}{0.5°}$ Up | 12° $\pm \frac{1.0°}{0.5°}$ Dn |
| 4 | Full clockwise travel | Streamline | 16.5° $\pm \frac{1.0°}{0.5°}$ Up | 16.5° $\pm \frac{1.0°}{0.5°}$ Dn |
| 5 | 4° LWD | Streamline | 4° ± 0.5° Dn | 4° ± 0.5° Up |
| 6 | 12° LWD | Streamline | 12° $\pm \frac{1.0°}{0.5°}$ Dn | 12° $\pm \frac{1.0°}{0.5°}$ Up |
| 7 | Full counter-clockwise travel | Streamline | 16.5° $\pm \frac{1°}{0.5°}$ Dn | 16.5° $\pm \frac{1°}{0.5°}$ Up |
| 8 | 0° | Full RWD* | 7.5° ± 0.75° Up | 7.5° ± 0.75° Dn |
| 9 | 16° RWD | Full RWD* | 24° ± 1.5° Up | 24° ± 1.5° Dn |
| 10 | 16° LWD | Full LWD* | 24° ± 1.5° Dn | 24° ± 1.5° Up |

*NOTE: Manually position ailerons until stops are contacted before trim tab measurements are taken.

D. Test Aileron Trim System Friction.

(1) Install tool 22-04304-19 on aileron trim knob to measure breakout force required to start trim knob turning.

(2) Secure ailerons in neutral position.

(3) Using test tool, rotate aileron trim knob CW from 0° to 16° on aileron trim indicator and check that breakout force does not exceed 15 inch-pounds at any trim tab position.

(4) Repeat step (3) substituting CCW for CW.

(5) Remove test tool from aileron trim knob.

E. Test Free Play in Trim Tab System.

(1) Secure left aileron in streamline position.

(2) Attach dial indicator to LH trim tab and adjust indicator so that plunger on indicator rests on trailing edge of LH flight tab.

(3) Attach spring scale to trailing edge of LH trim tab in line with trim tab horns.

(4) Using spring scale, pull up on trim tab until a 5-pound load is indicated.

(5) Maintain five-pound load on trim tab and adjust dial indicator to read $0^{\circ}$.

(6) Slowly release upward load on trim tab then apply a downward load of five pounds on trim tab.

(7) Check that movement of trim tab as indicated by dial indicator does not exceed 0.05 inch.

(8) Remove dial indicator and spring scale from LH trim tab.

(9) Repeat steps (2) through (8) substituting RH for LH.

(10) Remove equipment used to secure ailerons in neutral.

F. Conclusion.

When all tests are satisfactory, return airplane to normal configuration.

## AILERON/RUDDER TRIM CONTROL GEARBOX - MAINTENANCE PRACTICES

1. Removal/Installation Aileron/Rudder Trim Control Gearbox

A. Equipment Required.

(1) Two cable blocks.

(2) Standard cable tensiometer.

(3) Thermometer.

(4) Straightedge for streamlining aileron with wing and trim tab with aileron.

(5) Protractor No. 30-15000-901 RGTL #2 for streamlining rudder trim tab with rudder.

B. Remove Aileron/Rudder Trim Control Gearbox.

(1) Remove three STAB TRIM ELEC MOTOR limiters in ac power distribution box.

(2) Open STAB TRIM CONT EMER circuit breaker on main circuit breaker panel.

(3) Remove the two immediate UHF panels forward of RUDDER TRIM and PEDESTAL LIGHTS panel.

NOTE: Refer to Chapter 23, COMMUNICATIONS, for removal of components connected to these panels.

(4) Remove PEDESTAL LIGHTS control knob from top of pedestal.

(5) Disconnect electrical wiring from ELEC STBY STAB CONTROL switch and remove switch.

(6) Disconnect electrical wiring from STAB TRIM SEL switch and remove switch.

(7) Loosen turn buckles in aileron and rudder trim cables in cargo compartment.

(8) Remove RUDDER TRIM knob from top of pedestal and remove AILERON TRIM knob from aft side of pedestal.

(9) Remove RUDDER TRIM and PEDESTAL LIGHTS control panel from top of pedestal.

(10) Remove pedestal top panel center support from pedestal by removing bolt from each lower end and removing support from cross brace slots.

(11) Remove aft brace across bottom of pedestal and remove gearbox.

NOTE: The removal of the aileron rudder trim control gearbox does not necessitate the removal of the trim control cables from the gearbox. If cables are not being removed from gearbox for inspection or replacement when the gearbox is removed, they should be clamped at their respective drum with cable stop clamps to keep proper number of turns around cable drum. If cables are remaining in airplane, the remaining steps of the removal procedures will be altered only in that when the gearbox is removed from its pedestal mount, the cotter pins retaining the cable ends must be removed from the drum and the cable end fittings removed from the drum slots.

(12) Install cable stop blocks at each cable drum.

(13) Disconnect rudder and aileron cables at turnbuckles in forward cargo compartment. (Rudder trim cable turnbuckles are at fuselage station 441; aileron trim cable turnbuckles are at fuselage station 555.) Tag cables and attach a light guide line to swaged terminal of cable when terminal is disconnected from turnbuckle barrel. Guide line will facilitate installation of cables when gearbox is reinstalled.

(14) Remove keepers from rudder and aileron cable pulleys beneath pilots pedestal at fuselage station 237.35.

(15) Support gearbox and remove four nuts from counter sunk mounting screws.

(16) Remove gearbox by lowering and moving it forward and up through opening in top of pedestal.

NOTE: When removing gearbox, care should be taken to guide swaged cable terminal, with guide wires attached, through cable pulleys and other restrictions in area.

C. Install Aileron/Rudder Trim Control Gearbox.

NOTE: If cables have been removed from gearbox cable drums, check operation of rudder and aileron trim control mechanism for freedom of movement from stop to stop. Insert aileron and rudder trim cable ends in drum slots and insert cable and retainer cotter pins.

(1) Check cable drums on each side for a minimum of three turns from cable end fitting slot.

(2) Install cable blocks on cables to maintain proper number of turns on drum.

(3) Position gearbox in pedestal and install four mounting screws.

(4) Attach swaged cable terminals to guide lines and pull cables through pulleys.

(5) Install keepers in rudder and aileron cable pulleys beneath pilots' pedestal at fuselage station 237.35.

(6) In forward cargo compartment, connect swaged cable terminals to turnbuckle barrels. (Rudder trim cable turnbuckles are at fuselage station 441, aileron trim cables turnbuckles are at fuselage station 555.)

(7) Remove cable blocks.

(8) Tighten turnbuckles equally on aileron and rudder trim cables to a tension of 50 (±5) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pounds for each degree F (0.50 pounds for each degree C) increase or decrease respectively in free air temperature.

(9) Using straightedge, position and secure LH aileron in streamline position.

(10) Rotate aileron trim knob as necessary to position aileron indicator dial on 0 degrees and alternately loosen and tighten aileron trim cables until LH trim tab is streamlined with LH aileron.

(11) Recheck aileron trim cable tension, readjust if necessary, and secure turnbuckles with NAS 651 clips.

(12) Release LH aileron, position RH aileron in streamline position, and check that RH aileron trim tab is streamlined with aileron. If not, it will be necessary to adjust the aileron trim control linkage (refer to Adjustment/Test - Adjust Aileron Trim System).

(13) Install protractor No. 30-15000-901 RGTL #2 on trailing edge of rudder between rudder flight and trim tabs.

(14) Install rudder trim knob and rotate as necessary to position rudder indicator dial on 0 degrees and alternately loosen and tighten rudder trim cables until rudder trim tab is streamlined with rudder.

(15) Recheck rudder trim cable tension, readjust if necessary, and safety turnbuckles with NAS 651 clips.

(16) Install aft cross brace across bottom of pedestal.

(17) Install pedestal top panel center support by inserting in cross brace slots and installing bolt at each lower end of panel support.

(18) Install RUDDER TRIM and PEDESTAL LIGHTS control panel.

(19) Install RUDDER TRIM knob on top of pedestal and AILERON TRIM knob on aft side of pedestal.

CAUTION: DO NOT TIGHTEN EITHER KNOB MOUNTING BOLT MORE THAN REQUIRED TO REMOVE ALL END PLAY FROM SHAFT.

(20) Safety each knob mounting bolt. Mounting bolt safety wire twist to be inside cavity.

(21) Connect electrical wiring to STAB TRIM SEL switch and install.

(22) Connect electrical wiring to ELEC STBY STAB CONTROL switch and install.

(23) Install three STAB TRIM ELEC MOTOR limiters in ac distribution box, close STAB TRIM CONT EMER circuit breaker at main circuit breaker panel.

(24) Install pedestal light control knob.

(25) Check pedestal lights operation (refer to Chapter 33, LIGHTS).

(26) Install two UHF panels adjacent to and forward of RUDDER TRIM and PEDESTAL LIGHTS panel.

NOTE: Refer to Chapter 23, COMMUNICATIONS, for installation of components connected to these panels.

(27) Check aileron trim system operation (refer to 27-2-0, Adjustment/ Test Aileron Trim System Functional Test).

NOTE: If only the aileron/rudder trim control gearbox has been replaced and no other rigging or adjustment has been changed, check aileron trim system operation per 27-2-0, paragraphs 2.C. and 2.D.

(28) Check rudder trim system operation (refer to 27-8-0, Adjustment/ Test Rudder Trim System Functional Test).

NOTE: If the aileron/rudder trim control gearbox only has been replaced and no other rigging or adjustment has been changed, check rudder trim system operation per 27-7-0, paragraph 2.G.

## AILERON TRIM CONTROL JACK - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Trim Control Jack (see Figure 201)

   A. Equipment Required.

      (1) Standard cable tensiometer.

      (2) Two cable blocks.

      (3) Straightedge at least four feet long for streamlining aileron with wing and trim tab with aileron.

      (4) Thermometer.

   B. Remove Aileron Trim Control Jack.

      (1) Open GUST DAMPER access door and remove access panel forward of aileron trim tab on wing lower surface trailing edge.

      (2) Rotate aileron trim knob as necessary to position dial indicator on 0 degrees.

      (3) Clamp a cable block on each aileron trim cable at first pulley inboard of trim control jack.

      (4) Slack tension alternately and disconnect cables inboard of jack.

      (5) Disconnect two push-pull rods from aft side of jack.

      (6) Remove four mounting bolts and remove jack.

   C. Install Aileron Trim Control Jack.

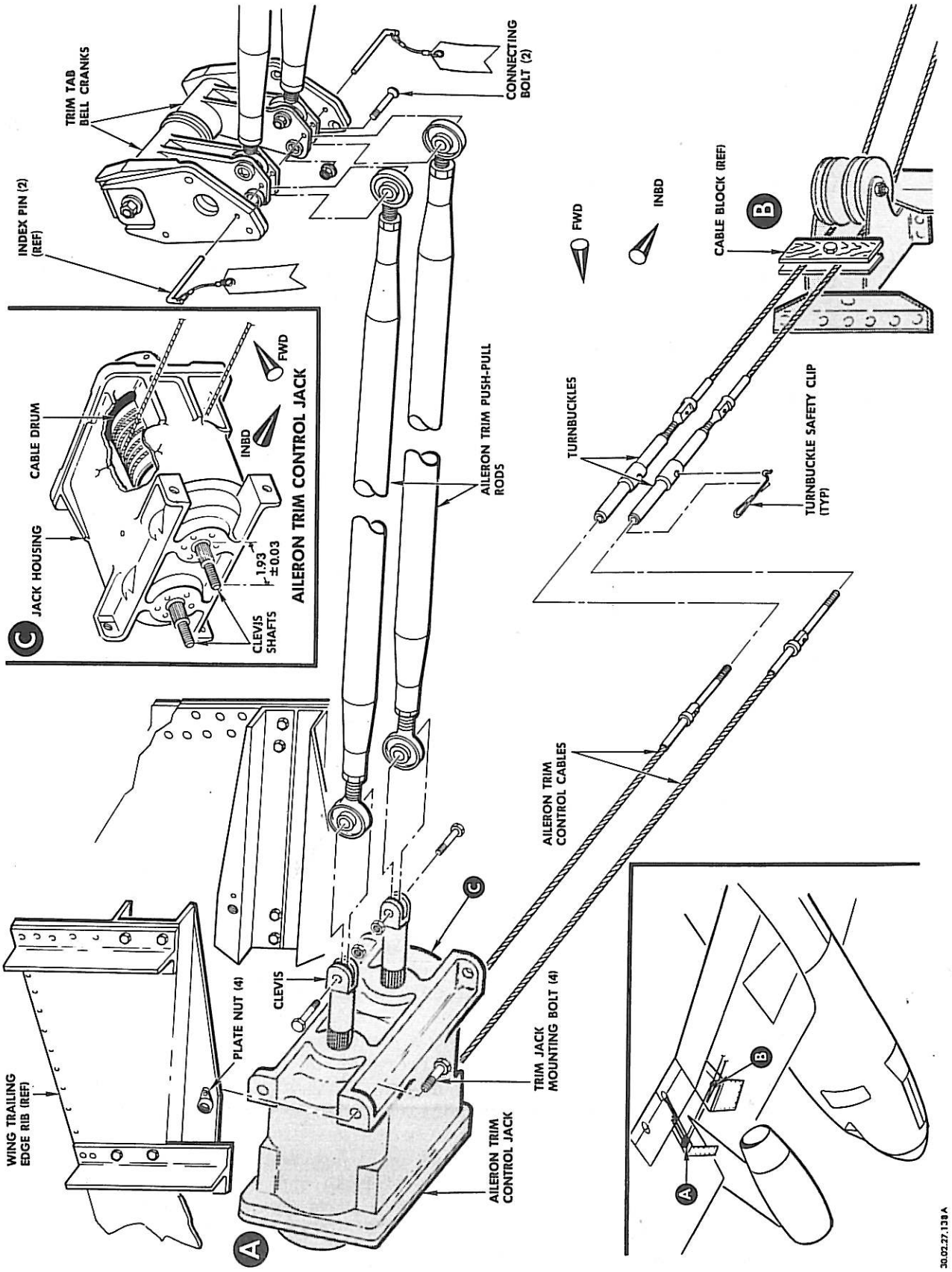
      (1) Check that each cable is wrapped approximately three and one-third turns around jack drum and that screw jack shafts protrude 1.93 (±0.03) inches from screw jack housing.

      (2) Position trim control jack in wing and install four mounting bolts.

      (3) Connect aileron trim control cables and remove cable blocks.

      (4) Tighten turnbuckles equally to a tension of 50 (±5.0) pounds at 70 degrees F (21 degrees C). Increase or decrease specified cable tension 0.25 pounds for each degree F (0.50 pounds for each degree C) increase or decrease respectively in free air temperature.

      (5) Set aileron trim indicator dial on 0 degrees and alternately loosen one aileron trim turnbuckle and tighten the other until trim jack shafts protrude 1.93 (±0.03) inches from screw jack housing. Recheck tension of aileron trim cables, readjust if necessary, and safety with NAS 651 clips.






Aileron Trim Control Jack Installation
Figure 201

## AILERON TRIM TABS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Trim Tabs (see Figure 201)

A. General.

Removal and installation procedures for LH and RH aileron trim tabs are identical. Neither aileron trim tab is balanced and trim tab installation will not affect aileron balance as long as tab's weight does not exceed 8.00 pounds. Trim tab weight is stamped on the tab nameplate. If trim tab is not within weight tolerance, the aileron must be rebalanced. (Refer to the 990 Structural Repair Manual for balancing instructions.)

B. Equipment Required.

(1) Stand suitable for reaching aileron.

(2) Straightedge at least four feet long for streamlining aileron with wing and streamlining trim tab with aileron.

(3) Graphite grease, Specification MIL-G-7187.

C. Remove Left Aileron Trim Tab.

(1) Open trim tab linkage access door on under surface of wing and remove trim tab bell crank fairing from leading edge of aileron, trim tab horn fairing from trailing edge of aileron, and hinge fairings from leading edge of trim tab.

(2) Disconnect aft end of trim control rods from trim tab horns. Install bolts loosely in control rods for installation.

(3) Remove three trim tab hinge bolts and slide trim tab aft to clear hinge fittings.

(4) Disconnect three bonding jumpers from trim tab hinge fittings.

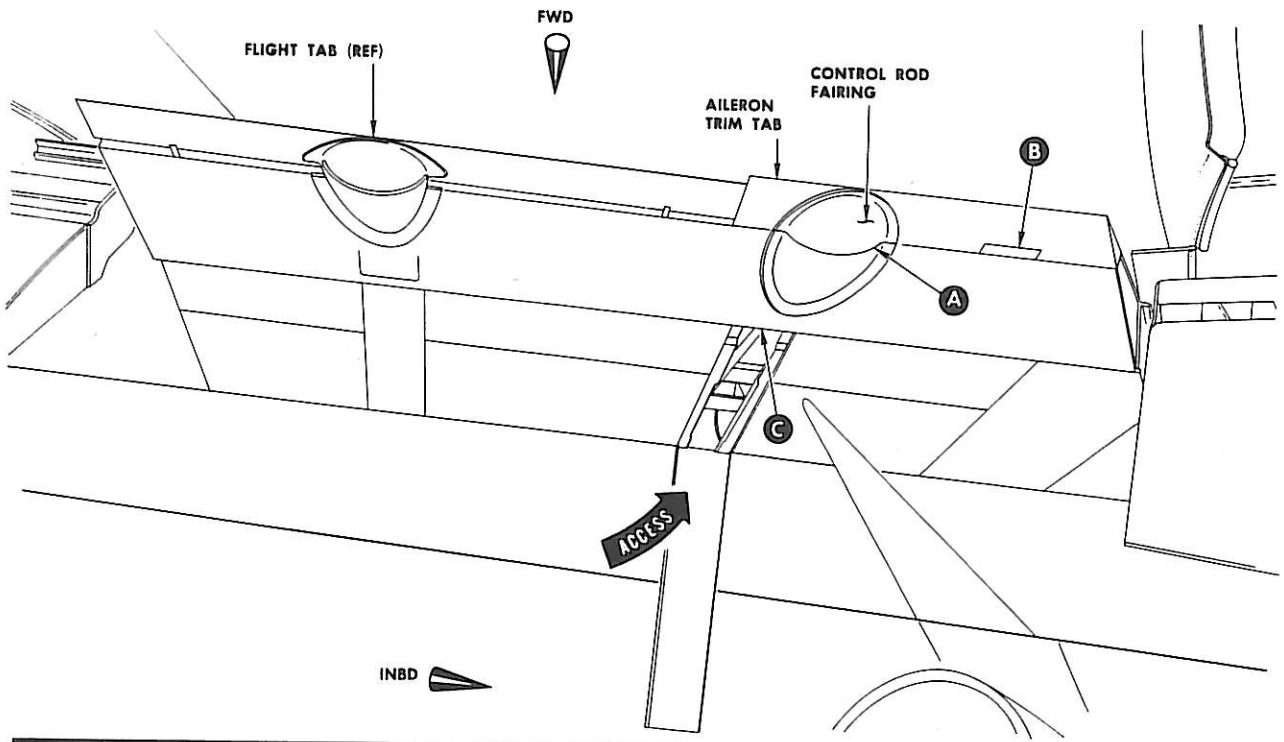
(5) Remove trim tab.

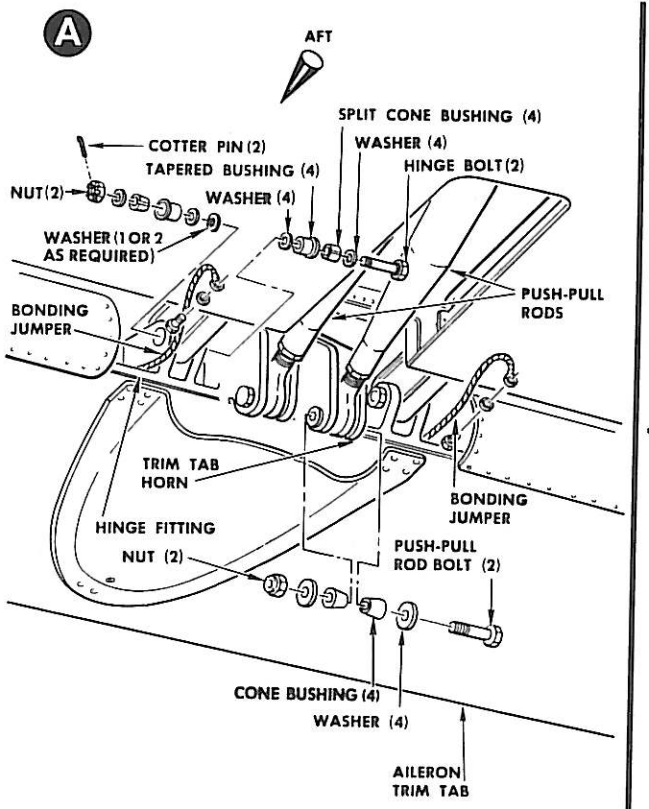
D. Install Aileron Trim Tab.

NOTE: Prior to installing aileron trim tabs, check bearings in trim tab bell crank two-bearing assemblies for evidence of binding on bolts, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

(1) Support trim tab and attach bonding jumpers to trim tab hinge fittings.

(2) Install hinge bolts and cone bushings (refer to 27-0, Installation Split Cone Bushings).




TRIM TAB CONTROL ROD AND OUTBOARD HINGE ATTACHMENTS

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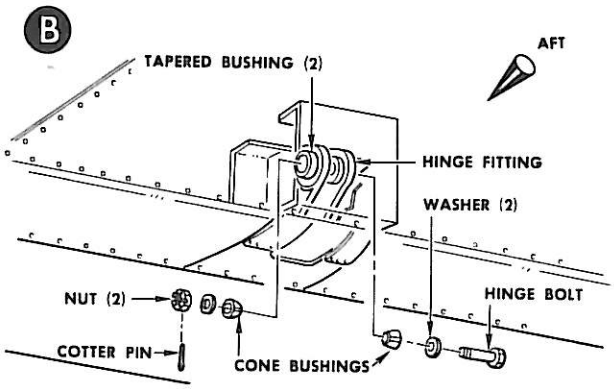
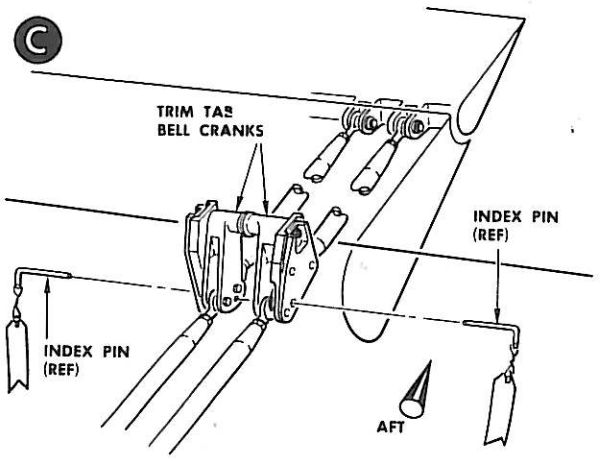



INBOARD HINGE ATTACHMENT




TRIM TAB RIGGING

## AILERON TRIM TABS - MAINTENANCE PRACTICES

1. Removal/Installation Aileron Trim Tabs (see Figure 201)

A. General.

Removal and installation procedures for LH and RH aileron trim tabs are identical. Neither aileron trim tab is balanced and trim tab installation will not affect aileron balance as long as tab's weight does not exceed 7.45 pounds. Trim tab weight is stamped on the tab nameplate. If trim tab is not within weight tolerance, the aileron must be rebalanced. (Refer to the 990 Structural Repair Manual for balancing instructions.)

B. Equipment Required.

(1) Stand suitable for reaching aileron.

(2) Straightedge at least four feet long for streamlining aileron with wing and streamlining trim tab with aileron.

(3) Graphite grease, Specification MIL-G-7187.

C. Remove Left Aileron Trim Tab.

(1) Open trim tab linkage access door on under surface of wing and remove trim tab bell crank fairing from leading edge of aileron, trim tab horn fairing from trailing edge of aileron, and hinge fairings from leading edge of trim tab.

(2) Disconnect aft end of trim control rods from trim tab horns. Install bolts loosely in control rods for installation.

(3) Remove three trim tab hinge bolts and slide trim tab aft to clear hinge fittings.

(4) Disconnect three bonding jumpers from trim tab hinge fittings.

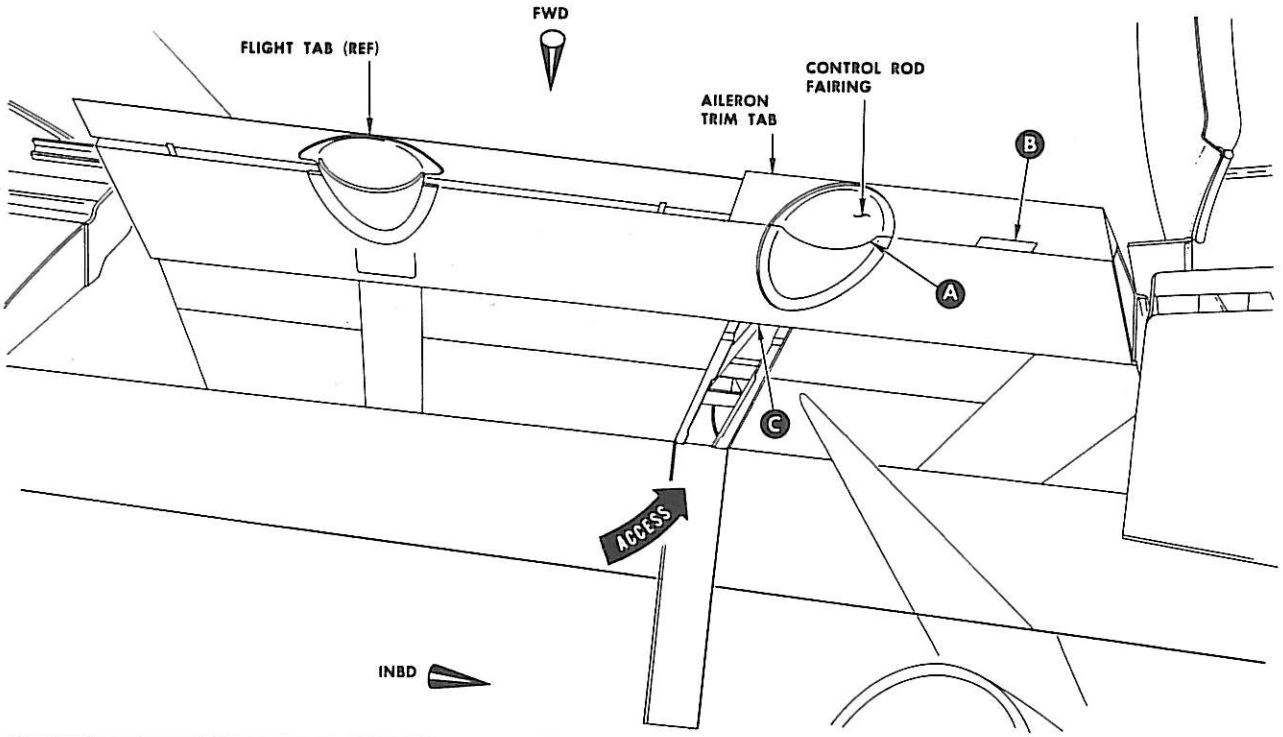
(5) Remove trim tab.

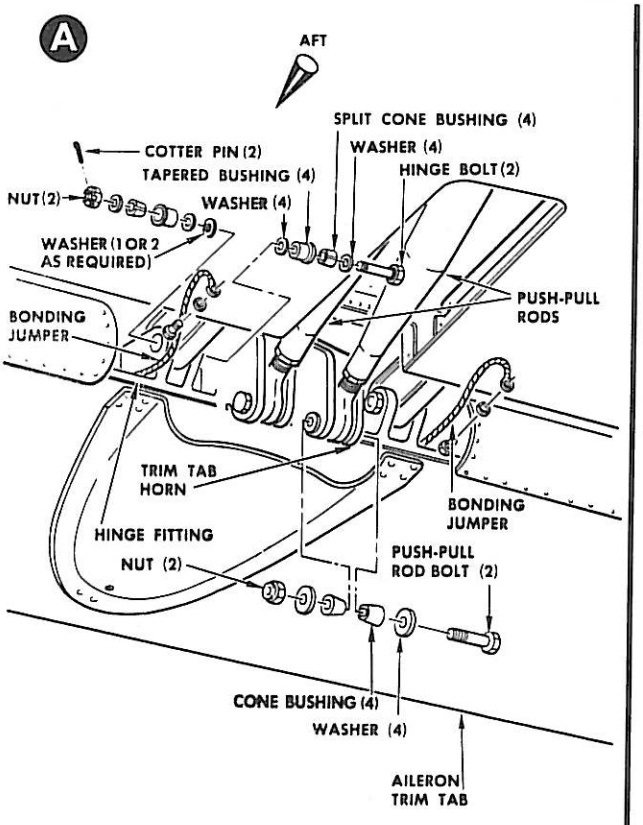
D. Install Aileron Trim Tab.

NOTE: Prior to installing aileron trim tabs, check bearings in trim tab bell crank two-bearing assemblies for evidence of binding on bolts, ratcheting, or excessive wear. Replace defective bearings (refer to 27-0, Bell Crank Bearing Installation - Typical).

(1) Support trim tab and attach bonding jumpers to trim tab hinge fittings.

(2) Install hinge bolts and cone bushings (refer to 27-0, Installation Split Cone Bushings).




TRIM TAB CONTROL ROD AND OUTBOARD HINGE ATTACHMENTS

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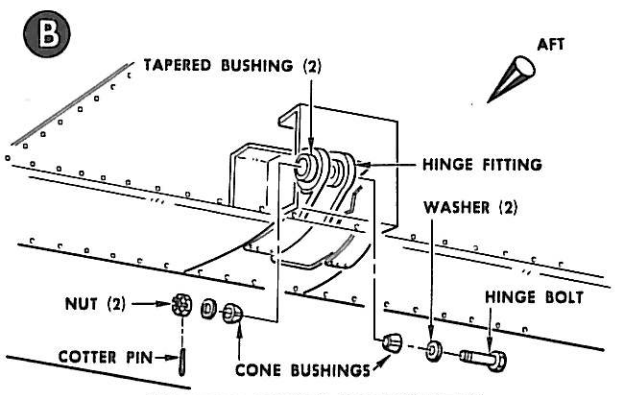
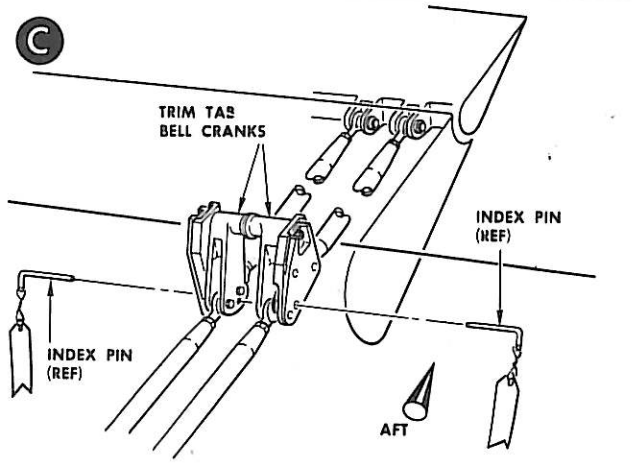



INBOARD HINGE ATTACHMENT




TRIM TAB RIGGING

(3) Rotate aileron trim knob as necessary to position aileron indicator dial on 0 degrees.

(4) Using straightedge, streamline aileron with wing and trim tab with aileron. Secure aileron and trim tab in position.

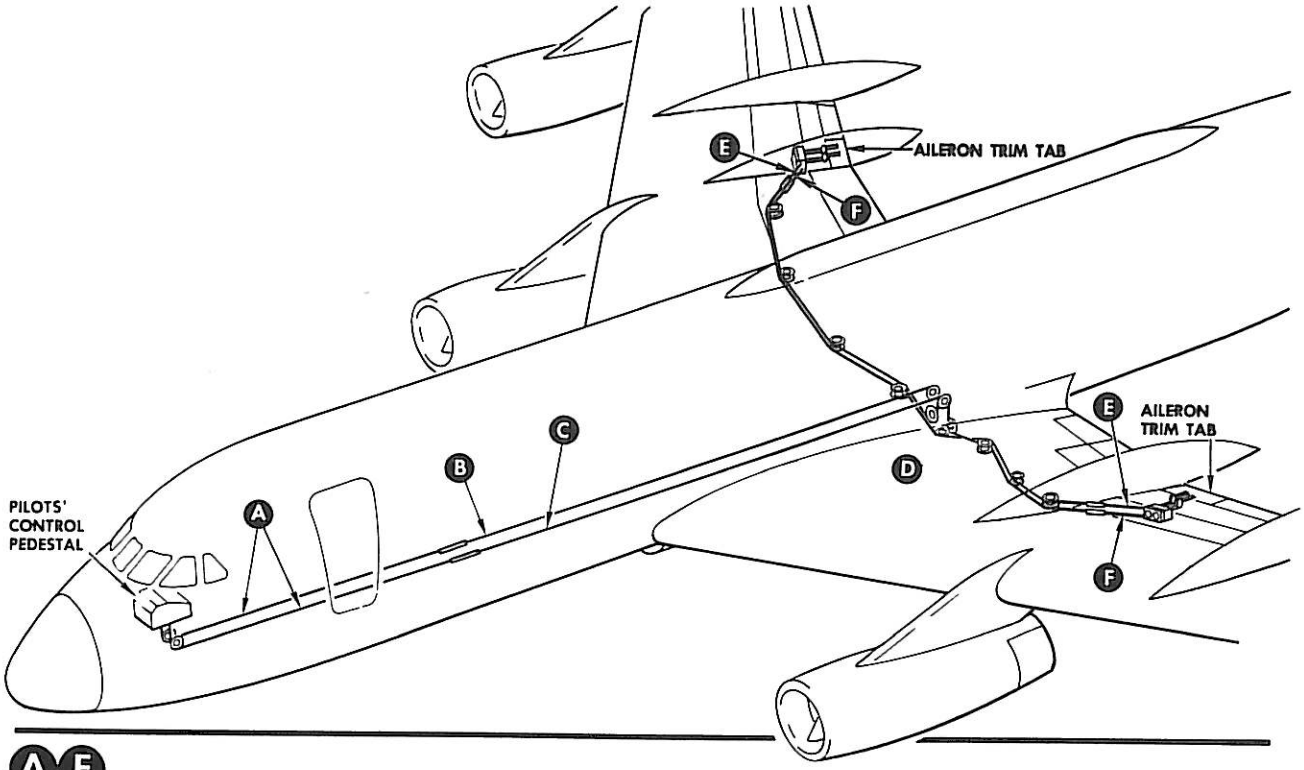
(5) Adjust trim tab control rods to distance between positioned trim tab bell cranks and trim tab horns and tighten check nuts on rod ends.

(6) Install aft end of control rods and bushings at trim tab horns (refer to 27-0, Installation Split Cone Bushings).

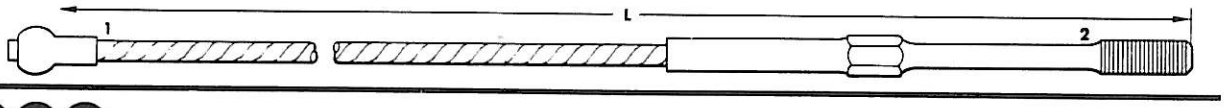
(7) Remove rigging tools.

(8) Test aileron trim system (refer to 27-2-0, Adjustment/Test Aileron Trim System).

NOTE: If an aileron trim tab only has been replaced and no other rigging or adjustment has been changed, check aileron trim system operation per 27-2-0, paragraphs 2.C., 2.D., and 2.E.




A F

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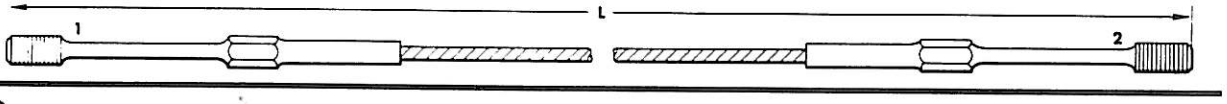


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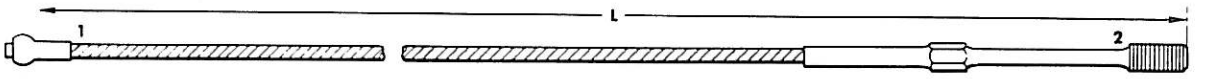



| CABLE REFERENCE | NUMBER REQUIRED | LENGTH | CABLE SIZE | FITTINGS 1 | FITTINGS 2 | |
|---|---|---|---|---|---|---|
| A | 2 | 312.40 | 3/32×7×7 | AN664C3 | NAS650-S3RH | |
| B | 1 | 737.20 | 3/32×7×7 | NAS650-L3LH | NAS650-S3LH | |
| C | 1 | 737.20 | 3/32×7×7 | NAS650-L3LH | NAS650-S3LH | |
| D | 1 | 498.20 | 3/32×7×7 | NAS650-L3RH | NAS650-L3RH | |
| E | 2 | 62.10 | 3/32×7×7 | AN664C3 | NAS650L3LH | |
| F | 2 | 62.10 | 3/32×7×7 | 22-44911-9 | NAS650L3RH | |

30.02.27.

# SPOILER CONTROL SYSTEM - DESCRIPTION AND OPERATION

## 1. General

An inboard and an outboard spoiler mounted on the upper surface of each wing immediately forward of the flaps provide the principal means of lateral control and also serve as speed brakes. The spoilers are raised and lowered by hydraulic actuators connected to the two hydraulic systems of the airplane through individual dual selector valves with followup mechanisms. These selector valves are connected mechanically through the spoiler/speed brake mixer to the pilots' control wheels and a speed brake handle mounted on the left side of the pilots' pedestal. Turning the control wheels actuates the spoilers in phase with the ailerons; moving the speed brake handle aft or forward raises or lowers the spoilers in unison (see Figure 1).

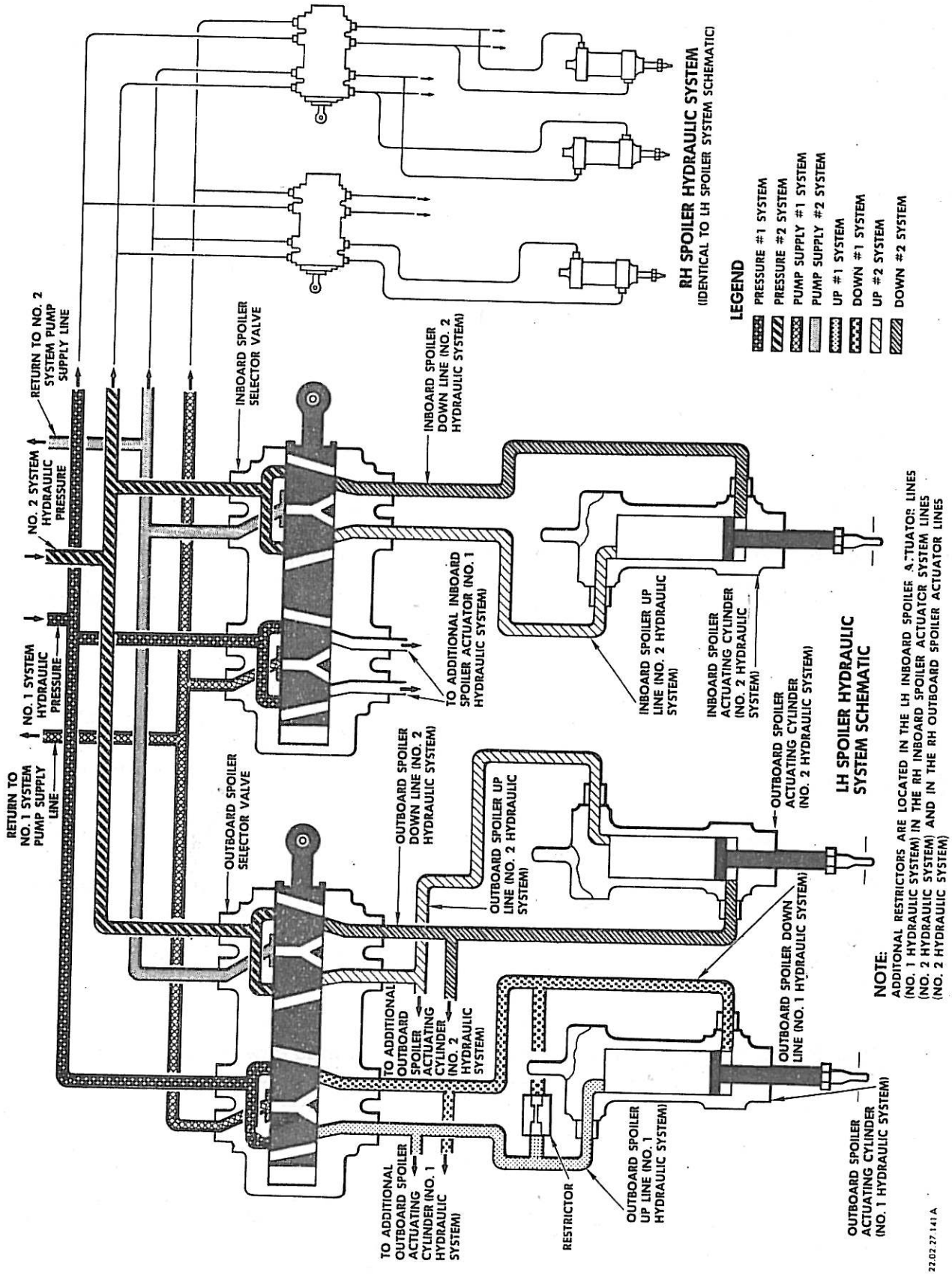
Each inboard spoiler is operated by two actuators; each outboard spoiler is equipped with four actuators. A push-pull rod connects each spoiler with the followup arm on its selector valve and shuts off the flow of hydraulic fluid to the actuators when the spoiler reaches the position corresponding to the current setting of the speed brake handle or the position of the control wheels. As one half of the actuators are powered by the No. 1 hydraulic system and the other half by the No. 2 hydraulic system, the spoilers can be operated as long as pressure is available in either hydraulic system.

The spoilers can be extended at any airspeed but they can be opened to full deflection only when the airspeed is less than 200 knots indicated. At higher speeds, the force exerted by the hydraulic actuators is sufficient to raise the spoilers to only some intermediate position. The deflection of the spoilers will change with variations in airspeed to keep the aerodynamic force on the spoilers in balance with the force available from the hydraulic actuators. Should one of the hydraulic systems lose pressure, "blow down" will occur at lower speeds but full deflection is still possible at speeds below 150 knots. A schematic diagram of the spoiler hydraulic system appears in Figure 2.

The spoiler and aileron systems are connected only through the spring-loaded crossover tube connecting the bell cranks at the base of the control columns (see 27-1-0, Figure 1). Force applied at the pilot's control wheel is transmitted to the aileron tabs through the linkage on the left-hand side of the airplane. The force is also carried through the spring tube into the linkage on the right-hand side of the airplane to the mixer unit and finally to the spoiler control valves.

Separate linkages for the aileron flight tabs and spoilers provide a safety feature. During normal operating conditions, either control wheel operates both systems. Should a malfunction occur causing one system to jam, the other system can be operated by overriding the jam through the spring-loaded crossover tube. A jam in the spoiler system on the right-hand side of the airplane can be overriden by the pilot to operate the aileron system. A jam in the aileron system can be overriden by the copilot to operate the spoiler system.

A
B
C
D
E
SPEED BRAKE INPUT TO MIXER
SPOILER HORIZONTAL LEVERS (2)
AILERON HORIZONTAL BELL CRANK (REF)
SPOILER INPUT TO MIXER
AILERON/SPOILER MIXER ASSEMBLY
F
MIXER CABLE QUADRANT AND "NO-BACK" DEVICE
AILERON/SPOILER CENTERING SPRINGS
SPOILER INPUT
SPEED BRAKE CONTROL ROD
SWINGING FRAME
HORIZONTAL CABLE PULLEY (2)
HORIZONTAL SPRING QUADRANT (2)
SPEED BRAKE PORTION OF MIXER
COPILOT'S CONTROL WHEEL (SPOILER INPUT)
PILOT'S CONTROL WHEEL (AILERON INPUT)
SPOILER CONTROL BELL CRANK TORQUE TUBE AND QUADRANT ASSEMBLY
SPEED BRAKE CABLE QUADRANT
MIXER CABLE QUADRANT AND "NO-BACK" DEVICE
SPEED BRAKE HORIZONTAL BELL CRANK (2)
INTERCONNECT BELL CRANK
INBOARD SPOILER CONTROL MECHANISM
INBOARD SPOILER HYDRAULIC ACTUATING CYLINDERS (2)
OUTBOARD SPOILER HYDRAULIC ACTUATING CYLINDERS (4)
SPOILER INTERMEDIATE IDLER
ADAPTER
ADAPTERS
OUTBOARD SPOILER CONTROL MECHANISM
SPOILER OUTBOARD IDLER
OUTBOARD SPOILER RETRACT ACTUATOR
INBOARD SPOILER RETRACT ACTUATOR
AUTOPILOT SERVO MOTOR
INBOARD IDLER ASSEMBLY
CONTROL COLUMN LOWER CABLE QUADRANT AND CRANK ASSEMBLY
SPOILER SPEED BRAKE CONTROL LEVER AND CABLE QUADRANT
SPOILER CONTROL FORWARD BELL CRANK
CONTROL COLUMN UPPER CABLE QUADRANT
SPRING-LOADED CROSSOVER TUBE
30.30.27.019 B






Spoiler Hydraulic System Schematic
Figure 2

The spoilers, when utilized as speed brakes, are controlled by the movement of a speed brake handle on the left side of the pilots' pedestal adjacent to the power levers. Moving the speed brake handle operates a cable and pulley system in the spoiler/speed brake mixer unit. The rotational movement of the pulleys is converted to linear motion by a push-pull tube and bell crank system. For speed brake operation, movement of the push-pull tubes to the selector valves is either inboard or outboard concurrently. This movement causes the spoilers to move up or down simultaneously as speed brakes (provided the ailerons are at neutral).

Basically, the aileron-spoiler association is as follows: With the spoilers flush against the upper wing surface (down position), only the spoilers on the up-aileron side will move; with the spoilers full open (up position), only the spoilers on the down-aileron side will move. With the spoilers in any position other than full up or full down, the spoilers move in the same direction as the ailerons, that is, one set of spoilers moves up, and the other set moves down.

When the spoilers are being used as speed brakes, either the inboard or the outboard spoilers can be lowered to provide additional pitch control if the horizontal stabilizer trim mechanism should jam. Actuating the emergency pitch control switch on the pilots' pedestal to the UP position lowers both inboard spoilers. The drag from the raised outboard spoilers tends to raise the nose of the airplane. Placing the emergency pitch control switch in the DOWN position, lowers the outboard spoilers and the drag from the raised inboard spoilers tends to lower the nose.

2. Spoiler Travel

Travel of the outboard spoilers is 60 (+3, -4) degrees and travel of the inboard spoilers is 72 (+5.0, -2.0) degrees "up" from the wing upper surface. Bottoming out of the spoiler hydraulic actuators limits spoiler travel in the retracted positions.

3. Spoiler Lateral Control and Operation

The spoiler/speed brake mixer assembly contains provisions to assure the proper operation of the spoilers for lateral control (see Figure 3). Mechanisms are contained within the mixer installation which allow the spoiler surfaces to move differentially and work with the ailerons, or allow the speed brake system to move the spoiler surfaces at the same time in the same direction, or to mix the two spoiler functions.

Spoiler lateral control is provided when motion of the cables in the right-hand side of the airplane is transmitted through a bell crank torque tube and a push-pull tube to a swinging frame in the mixer. A cable quadrant attached to the bell crank torque tube assembly aft of the main landing gear beam, connects the lateral control system to the autopilot servo. The system feel and centering cam is mounted on the swinging frame and operates about its pivot point, as do speed brake control actuated quadrants (left) and right). Rods connect each of these quadrants to levers which in turn are attached to push-pull rods extending outboard in the wings to the spoiler control valves.